HUC 11070206 – Lake O' the Cherokees
Water body IDs: 3278, 3279, 3280
Section 303(d) Listing: *Escherichia coli*

Total Maximum Daily Load

for

Lost Creek, Little Lost Creek, and Willow Branch

Newton County

Section 303(d) Listing: *Escherichia coli* Bacteria

Submitted: November 18, 2022
Approved: January 17, 2023

Prepared by: Water Protection Program, Watershed Protection Section

WATER BODY SUMMARY
Total Maximum Daily Loads (TMDL) for Lost Creek, Little Lost Creek, Willow Branch
Section 303(d) Listing: *Escherichia coli (E. coli)* Bacteria

Name: Lost Creek, Little Lost Creek, and Willow Branch

Location: Newton County

TMDL Development Priority: High

Location of watershed in Missouri

8-digit Hydrologic Unit Code (HUC):[1]
11070206 – Lake O' the Cherokees

Water Body Identification (WBID) and Hydrologic Class:[2]
WBID 3278 - Class P - Lost Creek
WBID 3279 - Class P - Little Lost Creek
WBID 3280 - Class C - Willow Branch

Designated Uses:[3]
Irrigation
Livestock and wildlife protection
Human health protection
Cool water habitat (WBID 3278 only)
Warm water habitat (aquatic life)
Whole body contact recreation category A (WBID 3278 only)
Whole body contact recreation category B (WBID 3279 and 3280 only)
Secondary contact recreation

Impaired Uses:
Whole body contact recreation categories A and B

Pollutant Identified on Missouri's 2020 Section 303(d) List:
Escherichia coli (E. coli) (fecal indicator bacteria)

Identified Sources on Missouri's 2020 Section 303(d) List:
Rural nonpoint sources

Length and Location of Impaired Segments:
WBID 3278 8.5 miles, from state line to Section 14, Township 25N, Range 33W
WBID 3279 5.8 miles, from mouth to Section 28, Township 25N, Range 33W
WBID 3280 2.2 miles, from mouth to Section 2, Township 25N, Range 33W

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[1] Watersheds are delineated by the U.S. Geological Survey using a nationwide system based on surface hydrologic features. This system divides the country into 2,270 8-digit hydrologic units (USGS 2019). A hydrologic unit is a drainage area delineated to nest in a multilevel, hierarchical drainage system. A hydrologic unit code is the numerical identifier of a specific hydrologic unit consisting of a 2-digit sequence for each specific level within the delineation hierarchy (FGDC 2003).

[2] For hydrologic classes see 10 CSR 20-7.031(1)(E). Class P streams maintain permanent flow even in drought periods. Class C streams may cease flow in dry periods but maintain permanent pools which support aquatic life.

[3] For designated uses see 10 CSR 20-7.031(1)(F) and 10 CSR 20-7.031 Table H. Presumed uses are assigned per 10 CSR 20-7.031(2)(A) and (B) and are reflected in the Missouri Use Designation Dataset described at 10 CSR 20-7.031(2)(F).

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1. Introduction

In accordance with Section 303(d) of the federal Clean Water Act, the Missouri Department of Natural Resources is establishing this total maximum daily load (TMDL) to address elevated concentrations of *Escherichia coli* (*E. coli*) bacteria in Lost Creek, Little Lost Creek, and Willow Branch in Newton County. This TMDL report addresses three water quality limited segments included on Missouri's 2020 Section 303(d) List of Impaired Waters due to exceedances of Missouri's *E. coli* bacteria criteria.[4] These listings were approved by the U.S. Environmental Protection Agency (EPA) on November 30, 2020.[5] Willow Branch is also listed as impaired for Cadmium and Zinc on the 2020 303(d) List. These metal impairments will be addressed in a future TMDL.

Section 303(d) of the federal Clean Water Act and Title 40 of the Code of Federal Regulations (CFR) Part 130 require states to develop TMDLs for waters that do not meet applicable water quality standards. Missouri's Water Quality Standards at Title 10 of the Code of State Regulations (CSR) Division 20 Chapter 7, Rule 7.031 consist of three major components: designated uses, water quality criteria to protect those uses, and an antidegradation policy. A TMDL is equal to the loading capacity of a water body for a specific pollutant and represents the maximum amount of a pollutant that a water body can assimilate and still attain and maintain water quality standards. The *E. coli* bacteria loading capacity for each water body is derived from the maximum *E. coli* concentration allowed by Missouri's Water Quality Standards and is translated to mass loads using stream flow under all recorded conditions. Once the loading capacity of a water body has been quantified, existing and future point sources and nonpoint sources are assessed for their potential to contribute the pollutants of concern. In accordance with 40 CFR 130.2, contributing point sources are assigned a portion of the available loading capacity as a wasteload allocation and nonpoint sources are assigned a load allocation. In accordance with federal Clean Water Act Section 303(d)(1)(C), a margin of safety is also included. Margins of safety can be explicit (numeric) or implicit (qualitative) to account for any lack of knowledge concerning the relationship between pollutant loading and water quality, uncertainty associated with the model assumptions, or data inadequacies (40 CFR 130.7). The TMDL for any given pollutant is the sum of the wasteload allocation, the load allocation, and the margin of safety.

2. Watershed Description

The Lost Creek watershed is located in southwest Missouri and encompasses the Little Lost Creek and Willow Branch watersheds (Figure 1). Lost Creek, water body identification (WBID 3278), originates six miles east of the Missouri border and flows southwest to the Neosho River in Oklahoma, which flows into the Grand Lake O' the Cherokee. The Lost Creek watershed is 60.2 square miles and is cataloged by the U.S. Geological Survey (USGS) as the 12-digit hydrologic unit (HUC) 110702060201. The subwatersheds of Little Lost Creek (WBID 3279) and Willow Branch (WBID 3280) are completely contained within the Lost Creek watershed. The Little Lost Creek subwatershed is 18.1 square miles and is located in the southern portion of the Lost Creek watershed. Little Lost Creek flows into Lost Creek approximately 80 feet upstream of the Missouri state border. The Willow Branch subwatershed is 13.5 square miles and is located in the

[4] A water quality limited segment is any segment where it is known that water quality does not meet applicable water quality standards, or is not expected to meet applicable water quality standards, even after the application of the technology-based effluent limitations required by sections 301(b) and 306 of the federal Clean Water Act (40 CFR 130.2).

[5] The Department maintains current and past Section 303(d) lists and corresponding assessment worksheets online at dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/impaired-waters.

northwestern portion of the Lost Creek watershed. Willow Branch flows into Lost Creek approximately 6.5 miles upstream of the confluence with Little Lost Creek.

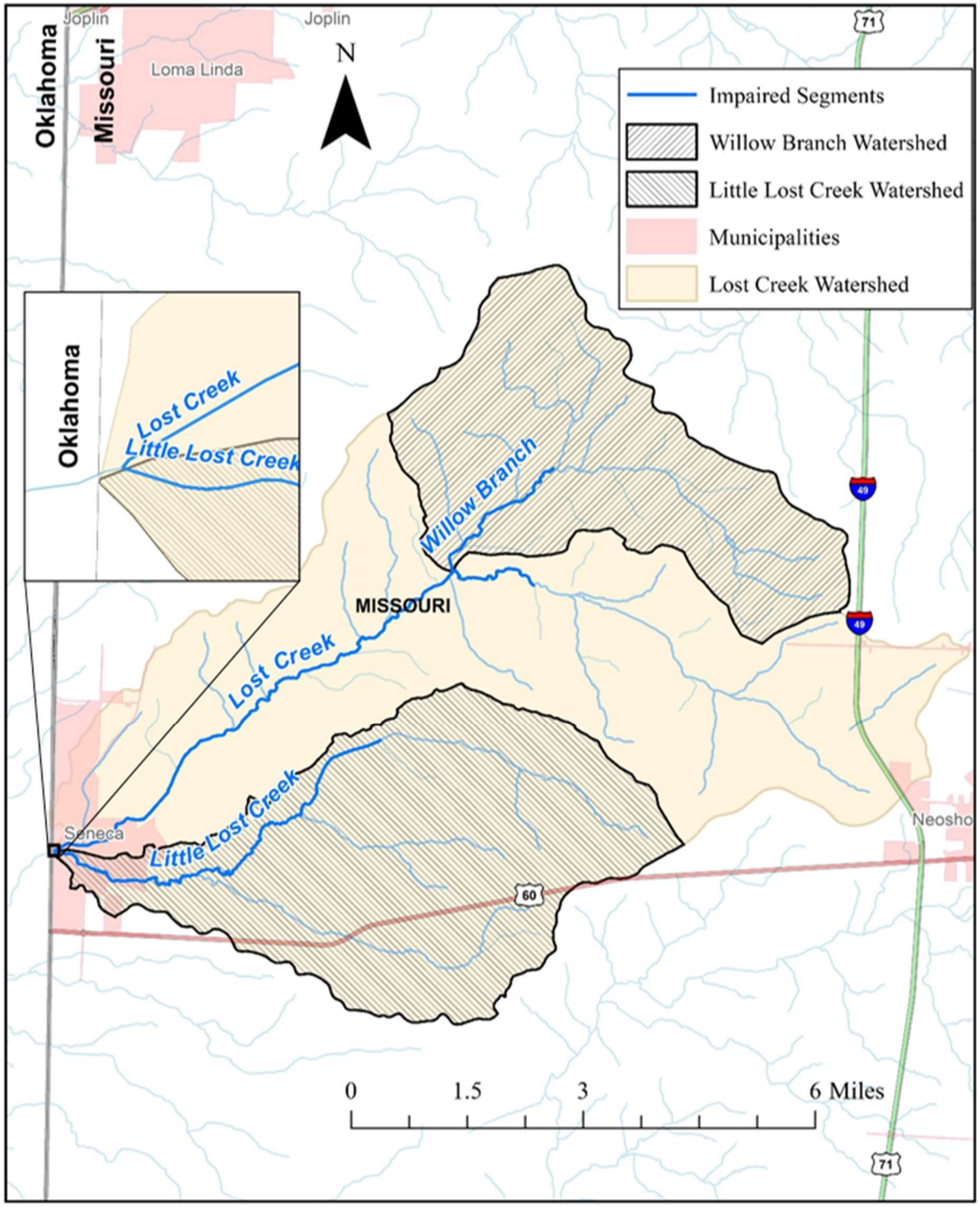

Figure 1. The Lost Creek watershed

2.1 Geology, Physiography, and Soils

The Lost Creek watershed is located within the Neosho ecological drainage unit, which primarily consists of southwest Missouri and northeast Oklahoma, with small portions of the drainage unit in

southeast Kansas and northwest Arkansas (MoRAP 2005). Ecological drainage units are groups of watersheds that have similar biota, geography, and climate characteristics. The Neosho ecological drainage unit is a transitional area that lacks distinctive features and shares many of the characteristics and aquatic biota of the Central Plains in the north and the Ozarks in the south. The Ozark aquatic subregion, which encompasses the Neosho ecological draining unit, is one of three subregions in Missouri that differ in geology, topology and soils, and also influence the distribution of aquatic life in the state. In general, streams in the Ozark aquatic subregion are heavily influenced by karst topography including increases in surface flows from springs or reductions due to losing streams. There are losing stream segments, four known springs, and one known sinkhole in the Lost Creek watershed. Streams in this subregion typically have lower nutrient loads, cooler temperatures and higher concentrations of dissolved oxygen (MoRAP 2005).

The Lost Creek watershed is also located in the Springfield Plateau EPA Level 4 ecoregion (ecological subsection). Ecoregions are areas with similar ecosystems and environmental resources and are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. By recognizing spatial differences in ecosystems, ecoregions stratify the environment by its probable response to disturbance (Chapman et al. 2002). The Springfield Plateau ecoregion is a smooth to gently rolling plain underlain by Mississippian-age cherty limestone with karst features and rocky soils. This region has a moderate topography and a potential vegetation of tallgrass prairie, deciduous forest, and savanna (MoRAP 2005).

Soils are categorized into hydrologic soil groups based on runoff potential. Each hydrologic soil group indicates the rate at which water enters the soil profile under conditions of a bare, thoroughly wetted soil surface (NRCS 2009). This infiltration rate determines the quantity of precipitation that flows over land to water bodies as direct runoff. Group A soils have the highest rate of infiltration and the lowest runoff potential. Group D soils have the lowest rate of infiltration and highest runoff potential. Many wet soils fall into dual soil groups (e.g., Group C/D) due to the presence of a seasonal high water table that results in saturation to the soil surface. Dual hydrologic soil groups account for this condition by providing both the drained and undrained condition of the soil.[6] It should be noted that soil runoff potential is only one factor that determines the volume of runoff in a watershed. Impervious surfaces, vegetative cover, slope, rainfall intensity, and land use can significantly influence the potential for runoff regardless of the characteristics of the underlying soil. Figure 2 shows the distribution of hydrologic soil groups in the Lost Creek watershed. Table 1 provides a summary of the hydrologic soil groups by area in square miles and relative percent.

[6] For the purpose of hydrologic soil groups, adequately drained means that the seasonal high water table is kept at least 24 inches below the surface in a soil where it would be higher in a natural state (NRCS 2009).

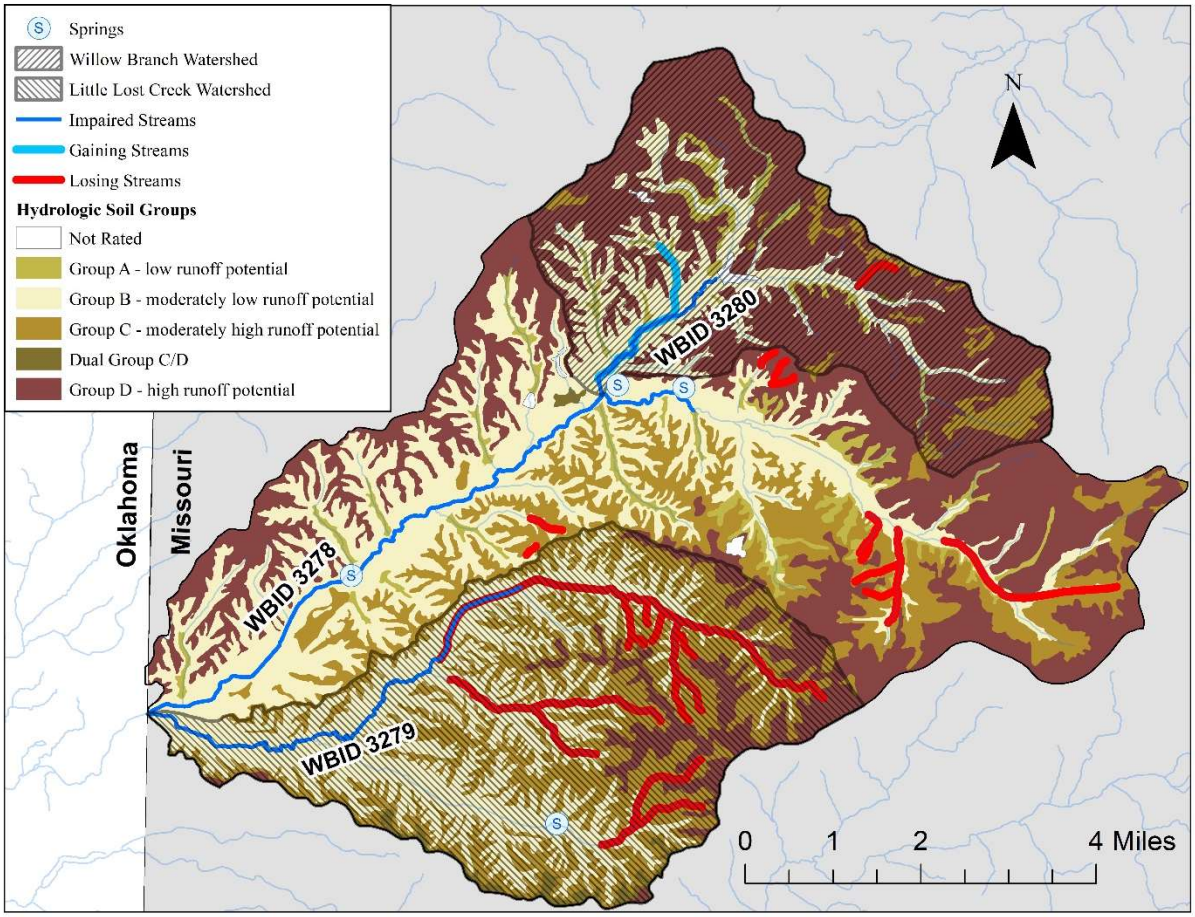

Figure 2. Hydrologic soil groups in the Lost Creek watershed

Table 1. Hydrologic soil groups in the greater Lost Creek watershed (NRCS 2020)

Hydrologic Soil Group	Area in the Watershed	
	Square miles	Percent
Lost Creek		
Group A	2.26	3.76%
Group B	22.51	37.41%
Group C	14.17	23.55%
Dual Group C/D	0.39	0.64%
Group D	20.68	34.37%
Not Rated	0.16	0.27%
Total	60.17	100.00%
Little Lost Creek		
Group A	0.06	0.33%
Group B	8.13	44.87%
Group C	7.40	40.83%
Dual Group C/D	0.33	1.84%
Group D	2.20	12.14%
Not Rated	0.00	0.00%
Total	18.12	100.0%

Willow Branch		
Group A	0.69	5.10%
Group B	3.08	22.76%
Group C	0.88	6.52%
Dual Group C/D	0.01	0.07%
Group D	8.78	64.97%
Not Rated	0.08	0.58%
Total	13.52	100.0%

2.2 Climate

The most recent climate data from a weather station in close proximity to the Lost Creek watershed were measured at the National Centers for Environmental Information Neosho Weather Station (USC00235976) in Newton County. The climate normals were developed based on temperature and precipitation data collected at that station between 1991 and 2020 (NOAA 2020). Precipitation normals are especially important because they relate to stream flow and runoff events that influence pollutant loading. Table 2 presents the 30-year monthly climate normals from the National Centers for Environmental Information Neosho Weather Station for precipitation and temperature. Figures 3 and 4 further summarize these data.

Table 2. 30-year monthly climate normals at the Neosho weather station

Month	Precipitation Total	Minimum Temperature	Maximum Temperature
	inches	ºF	ºF
January	2.55	25.3	46.3
February	2.41	29.0	50.9
March	3.70	38.0	60.0
April	5.31	47.0	69.7
May	6.74	57.0	77.2
June	5.70	66.2	85.2
July	4.20	70.4	89.8
August	3.65	68.3	89.4
September	4.99	59.7	82.2
October	4.14	47.8	71.5
November	3.70	37.8	59.5
December	2.87	29.0	49.4
	Total	Average	Average
	49.96	47.96	69.26

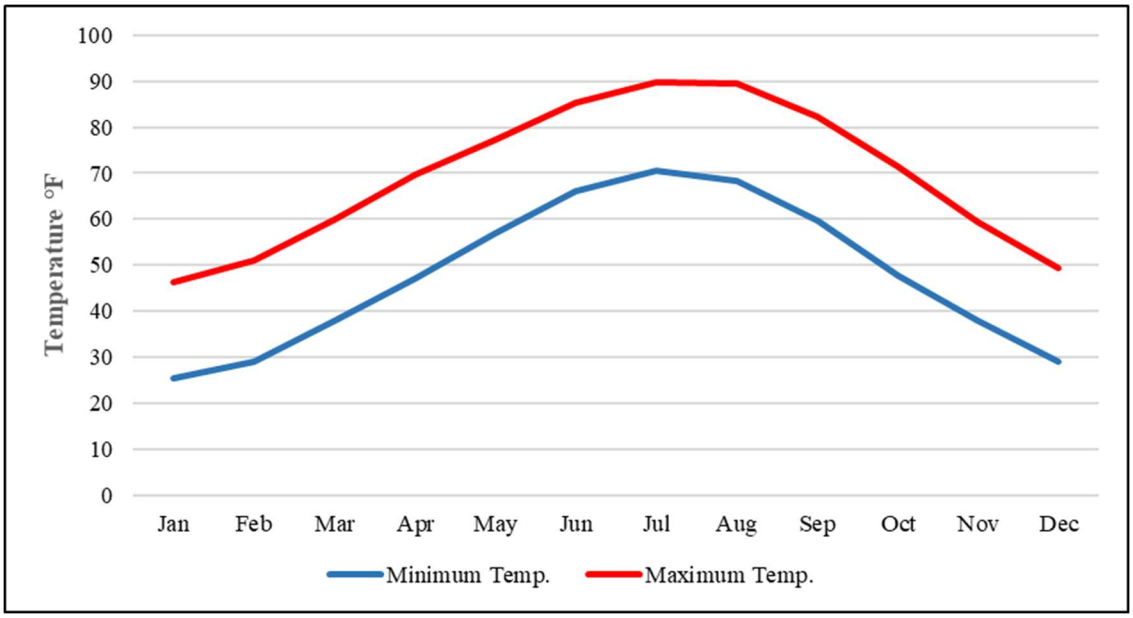

Figure 3. 30-year monthly temperature normals at the Neosho weather station

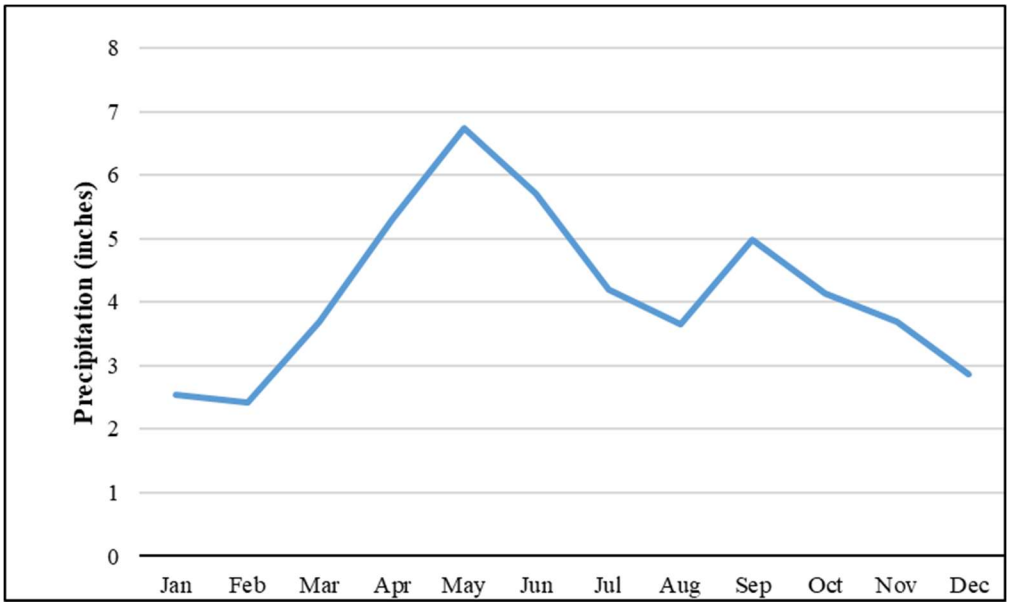

Figure 4. 30-year monthly precipitation normals at the Neosho weather station

2.3 Population

State and county population estimates are available from the U.S. Census Bureau's 2020 census and can be localized using census block data (U.S. Census Bureau 2020). Population estimates for the Lost Creek watershed were derived using geographic information system (GIS) software by overlaying the watershed boundary over a map of census blocks (Figure 5). Wherever the centroid of a census block fell within the watershed boundary, the entire population of the census block was included in the total. If the centroid of the census block was outside the boundary, the population of the entire block was excluded. The municipal population was estimated using a similar method whereby municipal areas were overlain on the map of census blocks. The rural population was

calculated as the difference between the municipal population and the total population. The population is predominately rural with 69 percent residing outside of municipal areas.

As shown in Table 3, the populations in the Lost Creek watershed have increased slightly since 2000. At the time of the 2020 census, the U.S. Census Bureau did not officially designate any urban areas in the Lost Creek watershed. Urban area designation is one criterion used to determine whether a municipality is subject to municipal separate storm sewer system (MS4) regulations. None of the municipalities in the Lost Creek watershed are subject to MS4 regulations.

Table 3. Population estimates for the Lost Creek watershed

Municipal			Rural			Total		
2000	2010	2020	2000	2010	2020	2000	2010	2020
Lost Creek								
1,680	1,804	1,603	3,636	3,969	3,967	5,316	5,773	5,570
Little Lost Creek								
653	659	648	894	949	973	1547	1608	1621
Willow Branch								
0	0	0	838	910	922	838	910	922

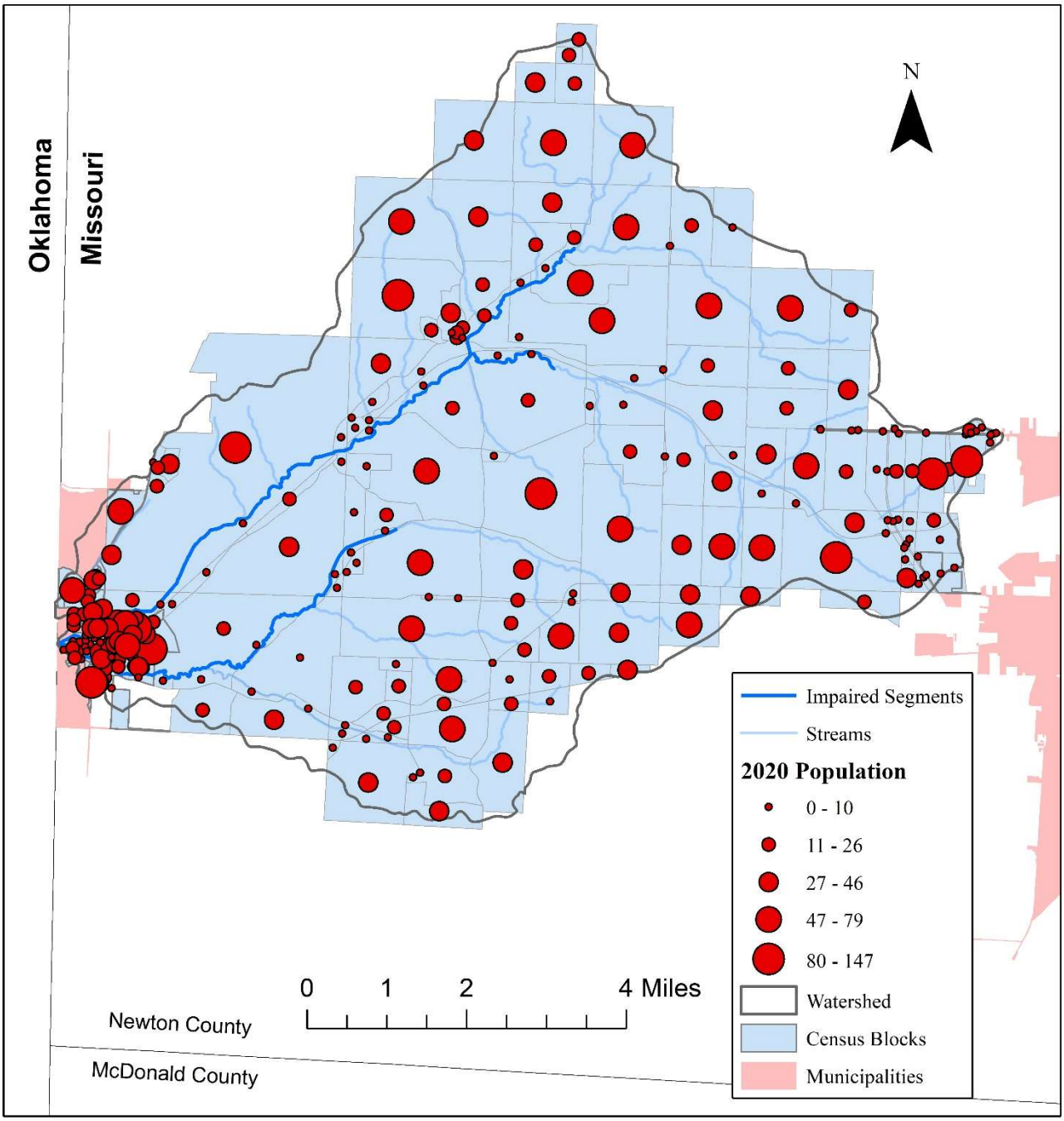

Figure 5. 2020 population in the Lost Creek watershed

Demographic data from the U.S. Census Bureau is included in EPA's web-based EJSCREEN tool and may be used to identify areas in the watershed with potential environmental justice concerns. The EJSCREEN tool is available at https://www.epa.gov/ejscreen. EPA defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to development, implementation, and enforcement of environmental laws, regulations and policies (USEPA 2014a). Communities determined to have environmental justice concerns may qualify for financial and strategic assistance for addressing environmental and public health issues. One example of financial assistance the Department offers that may be available to areas having environmental justice concerns is Section 319 grant funding to

address nonpoint source pollution. The Department evaluates 319 grants on a number of criteria, but gives higher priority for selection to proposed projects in disadvantaged communities. Additional grant and financial resource information is available on EPA's environmental justice website at https://www.epa.gov/environmentaljustice.

The EJSCREEN tool integrates 11 environmental pollution, 6 demographic indicators, and a demographic index based on percent low income and percent minority. EJSCREEN results highlight places that may be candidates for further review, analysis, or outreach to support EPA's environmental justice work. Information on the development, limitations, and intended uses of EJSCREEN, as well as access to the mapping tool can be found at the EJSCREEN website.

2.4 Land Cover

A land cover analysis was completed using the 2019 National Land Cover Database published by the USGS (Dewitz 2021). Land cover types present in the greater Lost Creek watershed are summarized in Tables 4-6. Figure 6 depicts the distribution of the land cover types throughout the watershed. As shown, the dominant land coverage in the Lost Creek watershed and Willow Branch subwatershed is hay and pasture areas potentially used for livestock grazing. The dominant land coverage in the Little Lost Creek subwatershed is forest, but hay and pasture areas still account for over 40 percent of the subwatershed.

Table 4. Land cover in the Lost Creek watershed

Land Cover Type	Lost Creek Watershed	
	Area Square Miles	Percent
Developed, High Intensity	0.14	0.23%
Developed, Medium Intensity	1.19	1.98%
Developed, Low Intensity	0.47	0.77%
Developed, Open Space	3.09	5.13%
Barren Land	0.02	0.03%
Cultivated Crops	0.14	0.24%
Hay and Pasture	30.21	50.21%
Shrub and Herbaceous	0.70	1.16%
Forest	24.10	40.06%
Wetlands	0.01	0.02%
Open Water	0.10	0.16%
Totals	**60.17**	**100.00%**

Table 5. Land cover in the Little Lost Creek watershed

Land Cover Type	Little Lost Creek Watershed	
	Area Square Miles	Percent
Developed, High Intensity	0.03	0.18%
Developed, Medium Intensity	0.37	2.06%
Developed, Low Intensity	0.10	0.55%
Developed, Open Space	0.95	5.25%

Barren Land	0.004	0.02%
Cultivated Crops	0.002	0.01%
Hay and Pasture	7.92	43.68%
Shrub and Herbaceous	0.12	0.67%
Forest	8.62	47.57%
Wetlands	0.00	0.00%
Open Water	0.00	0.00%
Totals	**18.12**	**100.00%**

Table 6. Land cover in the Willow Branch watershed

Land Cover Type	Little Lost Creek Watershed	
	Area Square Miles	Percent
Developed, High Intensity	0.002	0.02%
Developed, Medium Intensity	0.19	1.39%
Developed, Low Intensity	0.04	0.27%
Developed, Open Space	0.72	5.30%
Barren Land	0.01	0.08%
Cultivated Crops	0.00	0.00%
Hay and Pasture	7.67	56.73%
Shrub and Herbaceous	0.35	2.59%
Forest	4.48	33.14%
Wetlands	0.001	0.01%
Open Water	0.07	0.48%
Totals	**13.52**	**100.00%**

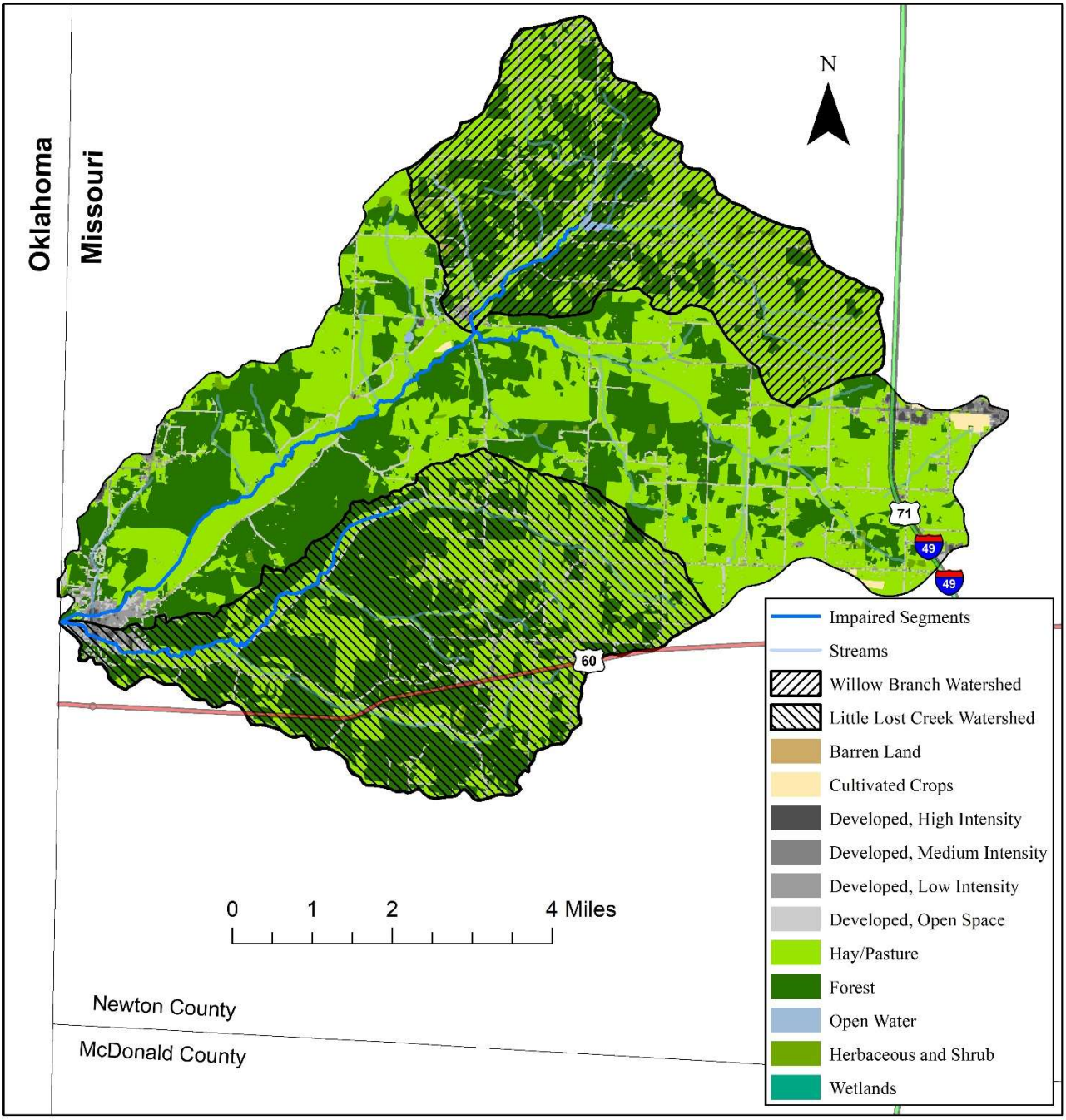

Figure 6. Land cover in the Lost Creek watershed

3. Applicable Water Quality Standards

TMDLs identify the maximum pollutant load that a water body can assimilate and still attain and maintain water quality standards. Water quality standards are therefore central to the TMDL development process. Under the federal Clean Water Act, every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters (U.S. Code Title 33, Chapter 26, Subchapter III). Water quality standards consist of three major components: designated uses, water quality criteria, and an antidegradation policy. In accordance with federal regulations at 40 CFR 131.10, Missouri's Water Quality Standards for each individual water body also provide for the attainment and maintenance of water quality in any downstream waters.

Revising existing water quality standards is not within the purview of TMDL development. If future water quality monitoring demonstrates that existing water quality standards are not protective of individual water bodies or downstream uses, new water quality standards can be proposed in accordance with the guidance provided in EPA's Water Quality Standards Handbook.[7]

3.1 Designated Uses

Missouri's Water Quality Standards at 10 CSR 20-7.031(1)(F) defines designated uses that are assigned to individual water bodies in accordance with 10 CSR 20-7.031(2) and are listed in 10 CSR 20-7.031, Table G (Lakes) and Table H (Streams). Missouri's Water Quality Standards designate the following uses of Lost Creek, Little Lost Creek, and Willow Branch:

- Irrigation
- Livestock and wildlife protection
- Human health protection
- Warm water habitat (aquatic life)
- Cool water habitat (aquatic life, Lost Creek only)
- Whole body contact recreation category A (Lost Creek only)
- Whole body contact recreation category B (Little Lost Creek and Willow Branch)
- Secondary contact recreation

The whole body contact recreation category A designated use of Lost Creek and whole body contact recreation category B for Little Lost Creek and Willow Branch are impaired due to high *E. coli* bacteria concentrations. Whole body contact recreation includes activities that involve direct human contact with waters of the state to the point of complete body submergence (10 CSR 20-7.031(1)(F)2.A.). During whole body contact activities, such as swimming, accidental ingestion of the water may occur and there is direct contact to sensitive body organs, such as the eyes, ears, and nose. Whole body contact category A applies to waters that have been established by the property owner as public swimming areas and waters with documented existing whole body contact recreation uses by the public (10 CSR 20-7.031(1)(F)2.A.(I)). Whole body contact category B applies to waters designated for whole body contact recreation not contained within category A (10 CSR 20-7.031(1)(F)2.A.(II)). Secondary contact recreation, which includes activities such as boating, fishing, and wading, are activities that may result in contact with the water that is either incidental or accidental and the probability of ingesting appreciable quantities of water is minimal (10 CSR 20-7.031(1)(F)2.B.). The secondary contact recreation use is not impaired in Lost Creek, Little Lost Creek, and Willow Branch.

3.2 Water Quality Criteria

Water quality criteria represent a level of water quality that supports and protects particular designated uses. Water quality criteria are expressed as specific numeric criteria and as general narrative statements. Missouri's Water Quality Standards (10 CSR 20-7.031(4) and (5)) establish general criteria applicable to all waters of the state at all times and specific criteria applicable to waters contained in 10 CSR 20-7.031, Tables G and H. Specific numeric *E. coli* bacteria criteria are given in Missouri's Water Quality Standards at 10 CSR 20-7.031(5)(C) and Table A1. For whole body contact recreation category A waters, *E. coli* concentrations during the recreational season (April through October) shall not exceed the geometric mean of 126 colony forming units (cfu) per 100 milliliters (mL) of water. In losing stream segments, *E. coli* concentrations shall not exceed

[7] https://www.epa.gov/wqs-tech/water-quality-standards-handbook

126 cfu as a maximum year round. For whole body contact recreation category B waters, *E. coli* concentrations during the recreational season (April through October) shall not exceed the geometric mean of 206 cfu/100 mL of water. These criteria are also protective of secondary contact recreational uses.

Little Lost Creek and Willow Branch flow into Lost Creek, which flows into neighboring Oklahoma. The primary body contact (whole body contact) recreation criterion for *E. coli* in Oklahoma is 126 cfu per 100 mL of water as a geometric mean based upon a minimum of not less than five samples collected over a period of not more than thirty days (Oklahoma OAC 785:45-5-16(c)(1)). The loading targets established in this TMDL for Lost Creek are consistent with applicable water quality standards in Oklahoma for the protection of primary body contact in that state. For this reason the TMDL is protective of downstream uses.

3.3 Antidegradation Policy

Missouri's Water Quality Standards include the EPA "three-tiered" approach to antidegradation and may be found at 10 CSR 20-7.031(3).

Tier 1 – Protects public health, existing instream water uses, and a level of water quality necessary to maintain and protect existing uses. Tier 1 provides the absolute floor of water quality for all waters of the United States. Existing instream water uses are those uses that were attained on or after November 28, 1975, the date of EPA's first water quality standards regulations related to existing uses.

Tier 2 – Protects and maintains the existing level of water quality where it is better than applicable water quality criteria. Before water quality in Tier 2 waters can be lowered, there must be an antidegradation review consisting of: (1) a finding that it is necessary to accommodate important economic and social development in the area where the waters are located; (2) full satisfaction of all intergovernmental coordination and public participation provisions; and (3) assurance that the highest statutory and regulatory requirements for point sources and best management practices for nonpoint sources are achieved. Furthermore, water quality may not be lowered to less than the level necessary to fully protect the "fishable/swimmable" uses and other existing uses.

Tier 3 – Protects the quality of outstanding national and state resource waters, such as waters of national and state parks, wildlife refuges, and waters of exceptional recreational or ecological significance. There may be no new or increased discharges to these waters and no new or increased discharges to tributaries of these waters that would result in lower water quality.

Waters in which a pollutant is at, near, or exceeds the water quality criteria are considered in Tier 1 status for that pollutant. Therefore, the antidegradation goals for Lost Creek, Little Lost Creek, and Willow Branch are to restore water quality to levels that meet water quality standards.

4. Defining the Problem

E. coli are bacteria found in the intestines of humans and warm-blooded animals, and are used as indicators of potential fecal contamination and risk of pathogen-induced illness to humans. In accordance with Missouri's 2020 Listing Methodology Document, the whole body contact recreation

category A (WBC-A) designated use for Lost Creek is impaired because the geometric means of *E. coli* samples collected during the recreational season (April 1 through October 31) were greater than 126 cfu/100 mL in the most recent three years having available data with five or more samples.[8] The whole body contact recreation category B (WBC-B) designated use for Little Lost Creek and Willow Branch is impaired because the geometric means of *E. coli* samples collected during the recreational season were greater than 206 cfu/100 mL in the most recent three years having available data with five or more samples. Sufficient data consistent with the assessment methodology are available to support these listings as summarized in Table 7 and Figure 7.

Individual *E. coli* measurements are provided in Appendix A, Table A-2, to illustrate the nature of the impairment, but were not used in the calculation of TMDL loading capacities or allocations. Individual measurements may be used to estimate existing loading and pollutant reduction targets to target implementation activities, and to select appropriate best management practices (BMPs). Reduction targets for Lost Creek, Little Lost Creek, and Willow Branch are presented in the supplemental TMDL implementation strategies document available online at dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/tmdls.

Table 7. Summary of available recreational season *E. coli* data for water quality assessment[9]

Water Body	Time Frame	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean (cfu/100 mL)
Lost Creek WBID 3278 (WBC-A criterion = 126 cfu/100mL)	2008	44	6.3	4,839.2	150.99
	2009	33	0.0	2,419.6	182.66
	2010	39	79.4	2,419.6	337.73
	2012	7	198.9	866.4	198.9
	2013	13	74.9	1,119.9	250.09
Little Lost Creek WBID 3279 (WBC-B criterion = 206 cfu/100mL)	2005	4	101.4	4,839.2	405.97
	2007	25	98.3	4,839.2	350.65
	2012	7	11.8	1,553.1	250.67
	2013	7	48.8	336.0	139.32
	2021	5	36.8	307.6	106.7
Willow Branch WBID 3280 (WBC-B criterion = 206 cfu/100mL)	2005	2	280.9	1,732.9	697.69
	2007	24	64.4	1,119.9	218.95
	2012	7	20.5	770.1	97.44

[8] Missouri's 2020 Listing Methodology Document is available online at dnr.mo.gov/document/methodology-development-2020-section-303d-list-missouri

[9] *E. coli* data may be reported in units of most probably number (MPN) or colony forming units (cfu) depending upon the analysis method used. Data reported as cfu is an actual count of bacteria colonies, whereas MPN is a statistical approximation. Although differences may exist, they are often used interchangeably. For purposes of this TMDL, all *E. coli* data are presented in units of cfu regardless of the methodology used for simplicity and in order to maintain consistency with Missouri Water Quality Standards.

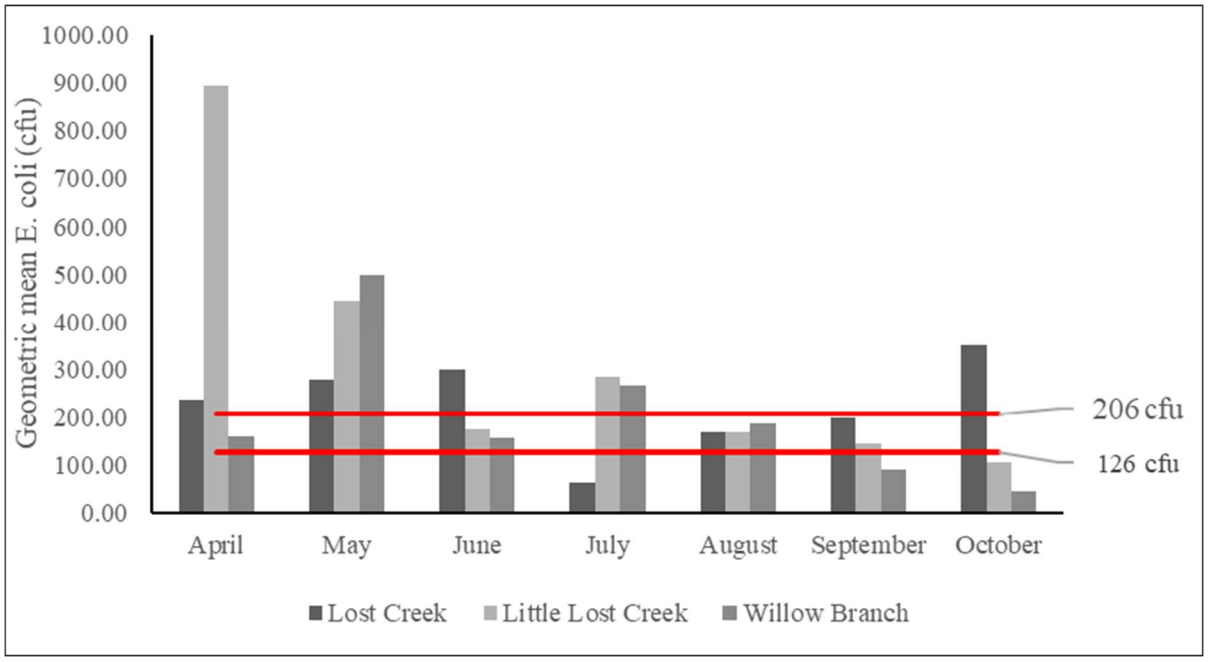

Figure 7. Geometric means for *E. coli* by month

5. Source Inventory and Assessment

Point (typically regulated) and nonpoint (typically unregulated) sources may contribute to the elevated *E. coli* concentrations in the impaired water bodies. The following source inventory and assessment identifies and characterizes known, suspected, and potential sources of bacteria loading to Lost Creek, Little Lost Creek, and Willow Branch. Sources of bacteria loading are identified and quantified to the extent that information is available.

5.1 Point Sources

Point sources are defined by Section 644.016(16) of the Missouri Clean Water Law and are regulated pursuant to the National Pollutant Discharge Elimination System through the Missouri State Operating Permit program.[10] A point source is defined as "any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. Point source does not include agricultural stormwater discharges and return flows from irrigated agriculture." Based on this definition, point sources include domestic wastewater treatment facilities, industrial and commercial facilities, concentrated animal feeding operations (CAFOs), MS4s, and stormwater discharges from industrial areas and construction sites. Illicit straight pipe discharges are also point sources but are illegal and therefore unpermitted. Pollutant loading from point sources is typically most evident during low-flow conditions when stormwater influences are lower or nonexistent. The locations of permitted point sources in Lost Creek, Little Lost Creek, and Willow Branch watershed are presented in Figure 8.[11] Facility types and their expected contributions to the impaired stream are described individually in the following sections.

[10] The Missouri State Operating Permit program is Missouri's program for administering the federal National Pollutant Discharge Elimination System (NPDES). Generally, the Clean Water Act requires all point sources that discharge pollutants to waters of the United States to obtain a NPDES permit. Issued and proposed operating permits are available online at dnr.mo.gov/water/business-industry-other-entities/permits-certification-engineering-fees.

[11] Each marker on the map represents an outfall. There may be multiple outfalls per facility.

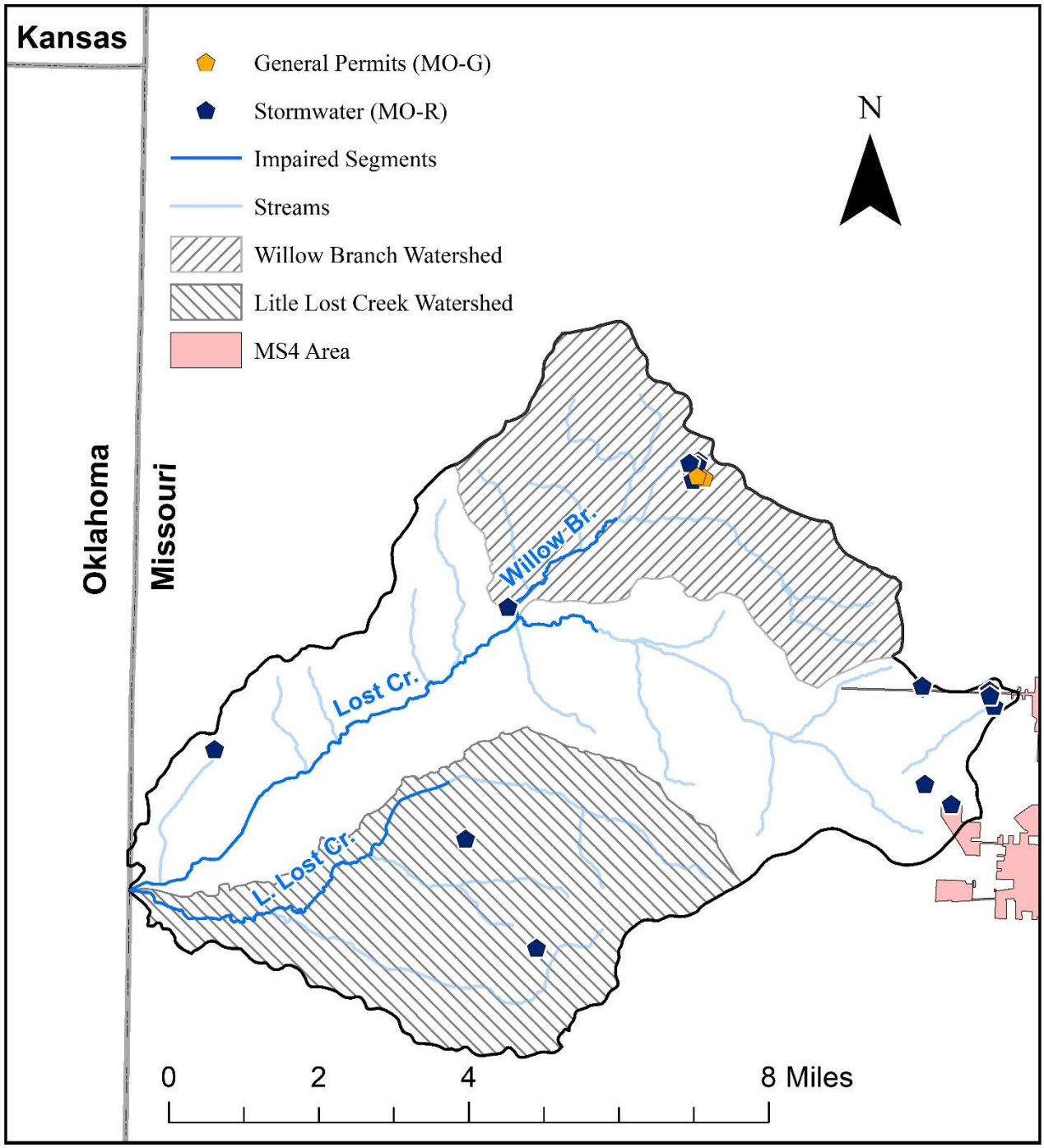

Figure 8. Permitted features and outfalls in the Lost Creek watershed

5.1.1 Domestic Wastewater Treatment Facilities

Domestic wastewater is primarily household waste, including graywater and sewage. Domestic wastewater treatment facilities include both publicly owned (municipal and sewer districts) and privately owned facilities. Untreated or inadequately treated domestic wastewater discharges can be significant sources of bacteria to receiving waters (USEPA 1986). When operating as designed, facilities utilizing disinfection technologies discharge *E. coli* at very low concentrations and are not expected to cause or contribute to bacteria impairments through discharges of treated effluent. The 4 State Moto Complex LLC (MO-G823203) is a domestic wastewater treatment facility located in the

Willow Branch watershed, which is also contained within the Lost Creek watershed. The permit for this facility does not authorize discharges to surface waters. Therefore when all permit conditions are met, this facility should not contribute bacteria loads to the impaired water bodies.

5.1.2 Industrial and Commercial Facilities

Industrial and commercial facilities discharge process water used or generated during mining, manufacturing, or food processing activities, and may also include landfills. Mining and manufacturing facilities are not expected to cause or contribute to bacteria impairments. Food processing wastewater may contain bacteria. There are no industrial or commercial facilities discharging process wastewater in the Lost Creek watershed.

5.1.3 Concentrated Animal Feeding Operations

Animal waste generated from CAFOs can be a source of bacteria to water bodies (Rogers, Shane, and Haines 2005). Pursuant to 10 CSR 20-6.300, permits are required for CAFOs that confine and feed or maintain more than 1,000 animal units for 45 days or more during any 12-month period.[12] Permits may be required for facilities with fewer animal units if pollutants are discharged directly into waters of the state or other water quality issues are discovered. There are no CAFOs present in the Lost Creek watershed.

5.1.4 Municipal Separate Storm Sewer Systems

Municipal separate storm sewer systems (MS4s) are stormwater conveyance systems owned by a public entity that are not part of a sanitary sewer system, a combined sewer system, or part of a domestic wastewater treatment facility. Federal regulations issued in 1990 require that discharges from MS4s be regulated by permits if the population of a municipality, or in some cases a county, is 100,000 or more (Phase I). As of 1999, federal regulations require permits for discharges from small MS4s that are located within a U.S. Census Bureau defined urban area or are required to hold a MS4 permit based on other criteria by the permitting authority (Phase II). In general, urban runoff may carry high levels of bacteria that may result in exceedances of water quality during and immediately after storm events (EPA 1983). Common sources of *E. coli* contamination in urban stormwater have been documented as originating from birds, dogs, cats, and rodents (Burton and Pitt 2002). Irrigation runoff from residential lawns where pet wastes are present may also contribute *E. coli* loads to surface waters. Approximately 47.9 acres (0.1 percent) of the Lost Creek watershed are contained within areas that may contribute stormwater runoff to the City of Neosho MS4 (MO-R040079) (Figure 8 and Table 8).

Stormwater discharges are often untreated, however MS4 permit holders must develop, implement, and enforce stormwater management program plans to reduce the input of harmful pollutants. These plans must include measurable goals, must be reported on annually, and must meet six minimum control measures and other applicable requirements. The six minimum control measures are public education and outreach, public participation and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention. It is expected that adequate compliance with the six minimum control measures will aid

[12] As defined by 10 CSR 20-6.300(1)(B)2, an animal unit is a unit of measurement to compare various animal types at an animal feeding operation. One (1) animal unit equals the following: 1.0 beef cow or feeder, cow/calf pair, veal calf, or dairy heifer; 0.5 horse; 0.7 mature dairy cow; 2.5 swine weighing over 55 pounds; 10 swine weighing less than 55 pounds; 10 sheep, lamb, or meat and dairy goats; 30 chicken laying hens or broilers with a wet handling system; 82 chicken laying hens without a wet handling system; 55 turkeys in grow-out phase; 125 chicken broilers, chicken pullets, or turkey poults in brood phase without a wet handling system.

in reducing bacterial loadings to the impaired streams. Additionally, due to the small proportion of area potentially contributing stormwater to the MS4, the Neosho small MS4 is not expected to contribute significant *E. coli* loads to surface waters in the Lost Creek watershed. There are no permitted MS4s in the Little Lost Creek or Willow Branch subwatersheds.

5.1.5 Other General Permitted Wastewater and Stormwater Discharges

General permits are issued for certain wastewater (MO-G) and stormwater (MO-R) discharges based on the type of activity and are intended to be flexible enough to allow for ease and speed of issuance, but must also protect water quality. General wastewater and stormwater permits are issued for activities similar enough to be covered by a single set of requirements. Table 8 lists other general or stormwater discharge permits in the Lost Creek watershed that have not already been discussed in other sections of this TMDL. Permits associated with construction or land disturbance activities (MO-RA) are temporary and the number of permits of this type may vary in any given year. Despite this variation, activities associated with general construction or land disturbance permits are not expected to cause or contribute to *E. coli* impairments when all permit conditions are met.

Existing and future activities for which general wastewater or stormwater permits are issued are expected to be conducted in compliance with all permit conditions including monitoring requirements and discharge limitations. Permit conditions are intended to protect the designated uses of all water bodies within the watershed. Activities conducted in accordance with general wastewater and stormwater permit requirements are not expected to contribute *E. coli* loads in amounts substantial enough to cause or contribute to surface water impairments. Per 10 CSR 20-6.010(13)(C), if at any time the Department determines that a general permit is not providing adequate water quality protection, the Department may require the owner or operator of a permitted site or activity to obtain a site-specific operating permit.

Table 8. Other General (MO-G) or stormwater (MO-R) permitted facilities in the Lost Creek, Little Lost Creek, and Willow Branch watersheds[13]

Water Body	Permit No.	Facility Name	Permit Type	Expires
Lost Creek WBID 3278	MO-R04C025	Neosho Phase II MS4	Comprehensive Phase II MS4	9/30/2026
	MO-RA15727	Kodiak Village	Construction or Land Disturbance	2/7/2027
	MO-RA16839	Seneca Turtle Stop		2/7/2027
	MO-RA18593	City of Neosho		2/7/2027
	MO-R130118	Ragland Mills, Inc.	Multiple Industry	9/6/2023
Little Lost Creek WBID 3279	MO-RA09890*	Kim Phillips	Construction or Land Disturbance	2/7/2027
	MO-RA18361*	Dollar General #23303 Neosho		2/7/2027
Willow Branch WBID 3280	MO-RA12716*	Dollar General #20179 Neosho	Construction or Land Disturbance	2/7/2027
	MO-RA18447*	Bo Johnson		2/7/2027
	MO-RA18448*	Bo Johnson		2/7/2027

*These permits are also located in the Lost Creek watershed.

[13]As of November 21, 2021

5.1.6 Illicit Straight Pipe Discharges

Illicit straight pipe discharges of domestic wastewater are also potential sources of bacteria loading to surface waters. These types of sewage discharges bypass treatment systems, such as septic tanks or sanitary sewers, and discharge directly to a stream or an adjacent land area (Brown and Pitt 2004). Illicit straight pipe discharges are illegal and are not authorized by the federal Clean Water Act or the Missouri Clean Water Law. At present, there are no data about the presence or number of illicit straight pipe discharges in the Lost Creek watershed. For this reason, it is unknown to what significance straight pipe discharges contribute bacteria loads to surface waters in the watershed. Due to the illegal nature of these discharges, any identified illicit straight pipe discharges must be eliminated. In areas with a regulated MS4, illicit discharge detection and elimination is a required permit condition.

5.2 Nonpoint Sources

Nonpoint sources are diffuse sources with no discernible, confined, or discrete conveyance, and include all categories of discharge that do not meet the definition of a point source. Nonpoint sources are not regulated by the federal Clean Water Act and are exempt from Department permit requirements by state regulation 10 CSR 20-6.010(1)(B)1. Nonpoint source pollutants are typically transported by stormwater runoff, which is minor or negligible during dry weather conditions. Nonpoint sources include agricultural lands, onsite wastewater treatment (septic) systems, and developed areas that do not have regulated storm sewer systems. Nonpoint source pollution can also result from natural background contributions, such as wildlife waste. Streams with little to no riparian buffer are most susceptible to nonpoint source pollution.

5.2.1 Agricultural Lands

Croplands, pasturelands, and low-density animal feeding operations are potential sources of bacteria in surface waters. Bacteria are transported in runoff from areas fertilized with animal manure and where livestock are present. Products containing or derived from sludges, biosolids, or other process wastes that are licensed under the Missouri Fertilizer law may be land applied as a fertilizer in the Lost Creek watershed in accordance with 10 CSR 20-6.015(3)(B)8. Runoff can result from precipitation or excessive irrigation. Soil and Water Conservation Districts provide funding and guidance for the development of nutrient management plans for unregulated private lands. Areas where nutrient management plans guide manure application and where BMPs are used to reduce soil erosion contribute less bacteria to surface waters than unmanaged areas. Although grazing areas are typically well vegetated, livestock tend to congregate near feeding and watering areas, which can create barren areas that are susceptible to erosion (Sutton 1990). Additionally, livestock that are not excluded from streams will deposit manure and thus bacteria directly into the waterway.

As noted in Section 2.4 of this document, agricultural areas (cropland and pastureland) account for 50.4 percent of the watershed. The exact type and number of livestock present in the Lost Creek watershed is unknown. An estimate of the number of cattle in the Lost Creek watershed was calculated by using the available land cover data in Section 2.4 and county cattle population numbers provided in the U.S. Department of Agriculture's 2017 Census of Agriculture (NASS 2017). Using the total number of cattle in Newton County and the proportion of the county's area of pastureland in the watershed to the total area of pastureland in the county, it is estimated that there

are 7,732 cattle in the entire Lost Creek watershed.[14] The U.S. Department of Agriculture estimates that a 1,000-pound beef cow produces approximately 59.1 pounds of manure per day (USDA 1995).

Other types of livestock such as horses and sheep may also be contributing bacteria loads in the Lost Creek watershed. The number and distribution of other animals in the watershed cannot be estimated from available data. Voluntary BMPs to reduce *E. coli* loading from agricultural areas are outlined in the supplemental Implementation Strategies document located at dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/tmdls.

5.2.2 Runoff from Developed Areas

Developed areas where stormwater discharges are not regulated through MS4 permits are nonpoint sources of *E. coli* loading. *E. coli* contaminated runoff can come from heavily paved areas and areas where soil erosion is common (Burton and Pitt 2002). Sources of *E. coli* within these developed areas are similar to those found in areas with permitted MS4s (see Section 5.1.4).

As presented in Section 2.4, developed areas cover small portions of the Lost Creek, Little Lost Creek, and Willow Branch watersheds. Low to high intensity development comprises approximately 2 to 3 percent and open space comprises approximately 5 percent. Degradation of water quality associated with imperviousness has been shown to first occur in a watershed at about 10 percent total imperviousness and to increase in severity as imperviousness increases (Arnold and Gibbons 1996; Schueler 1994). Due to the small amount of development in the watershed, runoff from developed areas is not expected to contribute substantial amounts of *E. coli* to the impaired water bodies. If the developed areas are expanded in the future, BMPs and low impact development should be considered to mitigate pollutant loading from impervious surfaces.

5.2.3 Onsite Wastewater Treatment Systems

Onsite wastewater treatment systems treat and disperse domestic wastewater on the property where it is generated. When properly designed and maintained, these systems perform well and should not contribute substantial amounts of *E. coli* to surface waters. However, when these systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface water quality (Horsley and Witten 1996). Domestic wastewater facilities with non-discharging earthen basins less than 3,000 gallons may operate under a permit exemption as described in (10 CSR 20-6.010(1)(B)11) and (10 CSR 20-6.015(3)(B)6). These facilities should not discharge and are therefore not expected to contribute *E. coli* to surface waters. The Missouri Department of Health and Senior Services or local administrative authorities (commonly the local health department) have jurisdiction over onsite wastewater treatment systems with a design or actual flow of 3,000 gallons per day or less. Municipalities or counties may impose more stringent or additional requirements for owners of septic systems. The Missouri Department of Health and Senior Services estimates that approximately 25 percent of homes in Missouri use onsite wastewater treatment systems, particularly in rural areas where public sewer systems are not available (DHSS 2018). Failing onsite wastewater treatment systems can contribute *E. coli* to nearby streams under wet or dry weather conditions directly or through surface runoff and groundwater flows. Factors that may contribute to onsite wastewater treatment system failure include age, inadequate land area,

[14] This analysis assumes all areas identified as hay and pasture are being used for cattle grazing and that cattle are evenly distributed among those areas. Additionally, although some animals may be confined in some areas, for purposes of this estimation the entire cattle population was assumed to be grazing on pasture areas.

poor soil for drainage, high water table, and inadequate maintenance. Proper maintenance of onsite residential wastewater treatment systems including septic tanks, associated drain fields, and household lagoons should minimize bacteria loading to surface waters.

The exact number of onsite wastewater treatment systems in the Lost Creek watershed is unknown. The Newton County Health Department reports that, on average, around 170 septic systems are permitted annually countywide (personal communication with Gail Stephens, Newton County Health Department Environmental Clerk, September 30, 2022). EPA's online input data server for the Spreadsheet Tool for Estimating Pollutant Load (STEPL) provides estimates of septic system numbers by 12-digit HUC watersheds based on 1992 and 1998 data from the National Environmental Service Center (USEPA 2014b).[15] According to the data provided by this server, there are approximately 885 septic systems in the Lost Creek watershed. Although there has been a slight increase in population since the 1990 census, this data is assumed to provide a reasonable estimate of actual septic system numbers.

Septic systems fail due to age and poor maintenance. A study by the Electric Power Research Institute suggests that in parts of Missouri, up to 50 percent of onsite wastewater treatment systems may be failing (EPRI 2000). Due to this high failure rate, onsite wastewater treatment systems are potential sources of bacteria loading to surface waters in Missouri. However, the significance of such contributions is unknown.

5.2.4 Natural Background Contributions

Wildlife such as deer, waterfowl, raccoons, rodents, and other animals contribute to the natural background concentrations of *E. coli* that may be found in a water body. Such contributions may be a component of runoff from agricultural areas, developed areas, forest lands, and other areas. While typical wildlife populations are not expected to cause or contribute to water body impairments, animals that congregate in large groups on or near water bodies may contribute significant amounts of bacteria to surface waters. For instance, Canada geese have been found to contribute significant bacteria loads in some waters (Ishii et al. 2007). There are no watershed-specific population data for waterfowl, but the Missouri Department of Conservation conducts statewide surveys in fall and winter. In 2020, waterfowl counts ranged from approximately 59,000 in October to 760,000 in late November (MDC 2021). The exact number of deer in the watershed is also not known, but the Missouri Department of Conservation keeps harvest records by county for each hunting season. Harvest data provides a general idea of the amount of deer that may be present in an area. The yearly harvests for the 2020 to 2021 season in Newton County was approximately 2,082 deer (MDC 2021). Bacteria can also be resuspended from benthic sediments as bacteria lives longer in sediment than in water (Davis and Barr 2006; Marino and Gannon 1991). Resuspension has been found to occur during sediment disturbance from activities such as dredging, boating in shallow area, and swimming. The significance of any resuspended bacteria to the impairments in Lost Creek, Little Lost Creek, and Willow Branch is unknown. Natural background contributions are included in the nonpoint source load allocation.

5.2.5 Riparian Corridor Conditions

Riparian corridor conditions have a strong influence on instream water quality. Wooded riparian buffers are a vital functional component of stream ecosystems and are instrumental in the

[15] The National Environmental Services Center is located at West Virginia University and maintains a clearinghouse for information related to, among other things, onsite wastewater treatment systems. Available URL: www.nesc.wvu.edu/

attenuation of pollutants in runoff. Land cover within 100 feet of streams in the Lost Creek, Little Lost Creek, and Willow Branch watersheds are presented in Tables 9 through 11. Agricultural areas constitute approximately 50 percent of the riparian corridors of streams in the Lost Creek watershed. These areas may be more susceptible to *E. coli* loading. Over 30 percent of the riparian corridors are forested. The Little Lost Creek and Willow Branch watersheds had a similar distribution of riparian land cover. This indicates that some *E. coli* transported from adjacent cropland and pasture lands into those areas may be intercepted before it enters the streams.

Table 9. Land cover in riparian corridors in the Lost Creek watershed

Land Cover Type	Total Watershed	
	Square Miles	Percent
Developed, High Intensity	0.006	0.21%
Developed, Low Intensity	0.052	1.94%
Developed, Medium Intensity	0.020	0.74%
Developed, Open Space	0.155	5.81%
Barren Land	0.000	0.00%
Cultivated Crops	0.001	0.05%
Hay/Pasture	1.484	55.54%
Shrub and Herbaceous	0.017	0.63%
Forest	0.903	33.81%
Wetlands	0.003	0.11%
Open Water	0.031	1.15%
Total	2.672	100.00%

Table 10. Land cover in riparian corridors in the Little Lost Creek watershed

Land Cover Type	Total Watershed	
	Square Miles	Percent
Developed, High Intensity	0.001	0.11%
Developed, Low Intensity	0.017	2.21%
Developed, Medium Intensity	0.004	0.50%
Developed, Open Space	0.044	5.59%
Barren Land	0.000	0.00%
Cultivated Crops	0.000	0.00%
Hay/Pasture	0.448	57.31%
Shrub and Herbaceous	0.000	0.04%
Forest	0.267	34.20%
Wetlands	0.000	0.00%
Open Water	0.0002	0.04%
Total	0.781	100.00%

Table 11. Land cover in riparian corridors in the Willow Branch watershed

Land Cover Type	Total Watershed	
	Square Miles	Percent
Developed, High Intensity	0.000	0.00%
Developed, Low Intensity	0.007	1.11%
Developed, Medium Intensity	0.003	0.44%
Developed, Open Space	0.037	5.78%
Barren Land	0.000	0.00%
Cultivated Crops	0.000	0.00%
Hay/Pasture	0.332	52.43%
Shrub and Herbaceous	0.009	1.46%
Forest	0.220	34.71%
Wetlands	0.001	0.12%
Open Water	0.025	3.96%
Total	0.633	100.00%

6. Calculating Loading Capacity

A TMDL is equal to the loading capacity of a water body for a specific pollutant, which is the maximum pollutant load that a water body can assimilate and still attain and maintain water quality standards. The loading capacity is derived from the numeric water quality criterion for each pollutant or an appropriate surrogate when no numeric criterion is applicable. Once the maximum allowable pollutant load is determined, a portion is assigned to point sources as a wasteload allocation and to nonpoint sources as a load allocation. A margin of safety is required to account for uncertainties in scientific and technical understanding of water quality in natural systems (CWA Section 303(d)(l)(C) and 40 CFR 130.7(c)(l)). The loading capacity is equal to the sum of the wasteload allocation, load allocation, and the margin of safety as follows:

$$TMDL = LC = \sum WLA + \sum LA + MOS$$

where LC is the loading capacity, ∑WLA is the sum of the wasteload allocations, ∑LA is the sum of the load allocations, and MOS is the margin of safety.

7. Total Maximum Daily Loads

According to 40 CFR 130.2(i), TMDLs can be expressed in terms of mass per unit time, toxicity, or other appropriate measures. The TMDLs for Lost Creek, Little Lost Creek, and Willow Branch are expressed as *E. coli* cfu per day using load duration curves developed using the applicable *E. coli* criterion concentration of either 126 or 206 cfu/100 mL, all possible stream flows, and a unit conversion factor.[16] The resulting load duration curves provide visual representations of the pollutant loading capacity of the water body at all stream flows. Using this approach, the available loading capacities of the streams vary with flow, but the pollutant concentrations remain constant. Establishing TMDLs using load duration curves is consistent with the Anacostia Ruling (*Friends of*

[16] $\boldsymbol{Load}\left(\frac{\text{count}}{\text{time}}\right) = \boldsymbol{Concentration}\left(\frac{\text{count}}{\text{volume}}\right) * \boldsymbol{Flow}\left(\frac{\text{volume}}{\text{time}}\right) * \boldsymbol{conversion\ factor}$ (24,465,715)

the Earth, Inc., et al v. EPA, No 05-5010, April 25, 2006) and EPA guidance in response to that ruling (USEPA 2006; USEPA 2007a).

The TMDL targets are the *E. coli* criteria established by Missouri's water quality standards for protection of whole body contact recreational uses, or losing stream criteria if applicable. The TMDL target for Lost Creek (WBC-A) is 126 cfu/100mL. The TMDL target for Willow Branch (WBC-B) is 206 cfu/100mL. The TMDLs for Lost Creek and Willow Branch are applicable during the recreational season (April-October) when the *E. coli* criteria apply. Although Little Lost Creek is designated for WBC-B, for purposes of this TMDL the target for Little Lost Creek is based on losing stream criteria of 126 cfu/100mLwhich is applicable year round. This is because the upper 1.4 miles of the impaired segment is identified as a losing stream. This provides a conservative target that is protective of all recreational uses in Little Lost Creek.

Although the TMDLs are expressed as daily mass loads, *E. coli* criteria are expressed as geometric mean concentrations. Therefore, fluctuations in instantaneous concentrations are expected and individual bacteria measurements greater than the applicable criterion do not necessarily indicate violations of water quality standards. Additional discussion about the methods used to develop the load duration curves for Lost Creek, Little Lost Creek, and Willow Branch are provided in Appendix B.

Observed data are plotted on the load duration curve graphs to illustrate the frequency of exceedance and the magnitude of load reductions needed to meet the TMDL and attain water quality standards. Points above the curve exceed the loading capacity and points on or below the curve are in compliance with water quality standards. Load duration curves also help to identify and differentiate between storm-driven loading and the presence of continuous loading. Storm-driven loading is expected under wet conditions when precipitation and runoff are high. Continuous loading is evident at low flows when point source discharges have greater influence on water quality. Load reductions needed to meet the *E. coli* criterion can be estimated using the geometric means of observed data within each flow percentile range and are provided in the supplemental Implementation Strategies document located at dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/tmdls.

The *E. coli* load duration curves for Lost Creek, Little Lost Creek, and Willow Branch are displayed in Figures 9 through 11. The y-axis quantifies the *E. coli* mass load in cfu per day at the flow conditions (percentage of time flow is equaled or exceeded) on the x-axis. Lower flows are equaled or exceeded more frequently than higher flows (i.e., greater than 90 percent of the time). The flow ranges presented are consistent with EPA guidance for using load duration curves to develop TMDLs (USEPA 2007b).

The TMDLs and associated allocations at selected percentile flow exceedances are displayed in Tables 12 through 14. The loading capacity was calculated using the applicable target concentrations of either 126 or 206 cfu/100 mL based on the water quality criterion applicable to each water body. Due to the extremely large numbers associated with bacteria loads, *E. coli* values are presented using scientific notation. Specific allocations for individual sources are discussed in Sections 8 and 9.

Table 12. *E. coli* TMDL and Allocations for Lost Creek at Selected Flows

Percent of time flow is equaled or exceeded	Flow ft^3/s	LC (counts/day)	∑WLA (counts/day)	∑LA (counts/day)	MOS (counts/day)
95	4.40	1.36E+10	0.00E+00	1.22E+10	1.36E+09
75	13.13	4.05E+10	0.00E+00	3.64E+10	4.05E+09
50	27.07	8.35E+10	0.00E+00	7.51E+10	8.35E+09
25	62.22	1.92E+11	0.00E+00	1.73E+11	1.92E+10
5	207.69	6.40E+11	0.00E+00	5.76E+11	6.40E+10

Table 13. *E. coli* TMDL and Allocations for Little Lost Creek at Selected Flows

Percent of time flow is equaled or exceeded	Flow ft^3/s	LC (counts/day)	∑WLA (counts/day)	∑LA (counts/day)	MOS (counts/day)
95	1.32	4.08E+09	0.00E+00	3.67E+09	4.08E+08
75	3.95	1.22E+10	0.00E+00	1.10E+10	1.22E+09
50	8.14	2.51E+10	0.00E+00	2.26E+10	2.51E+09
25	18.71	5.77E+10	0.00E+00	5.19E+10	5.77E+09
5	62.44	1.92E+11	0.00E+00	1.73E+11	1.92E+10

Table 14. *E. coli* TMDL and Allocations for Willow Branch at Selected Flows

Percent of time flow is equaled or exceeded	Flow ft^3/s	LC (counts/day)	∑WLA (counts/day)	∑LA (counts/day)	MOS (counts/day)
95	0.99	4.97E+09	0.00E+00	4.47E+09	4.97E+08
75	2.94	1.48E+10	0.00E+00	1.34E+10	1.48E+09
50	6.07	3.06E+10	0.00E+00	2.75E+10	3.06E+09
25	13.95	7.03E+10	0.00E+00	6.33E+10	7.03E+09
5	46.57	2.35E+11	0.00E+00	2.11E+11	2.35E+10

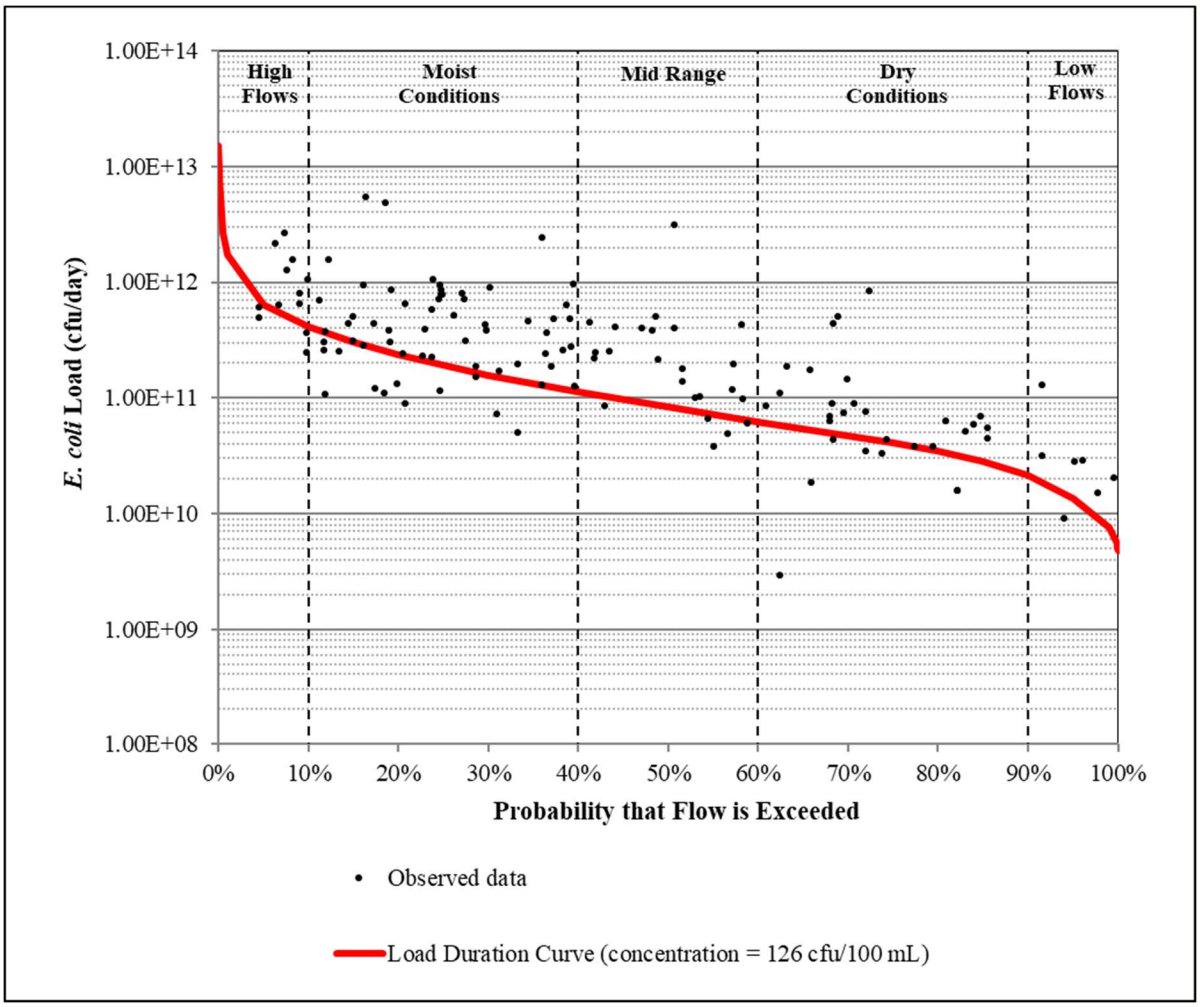

Figure 9. *E. coli* TMDL for Lost Creek (WBID 3278)

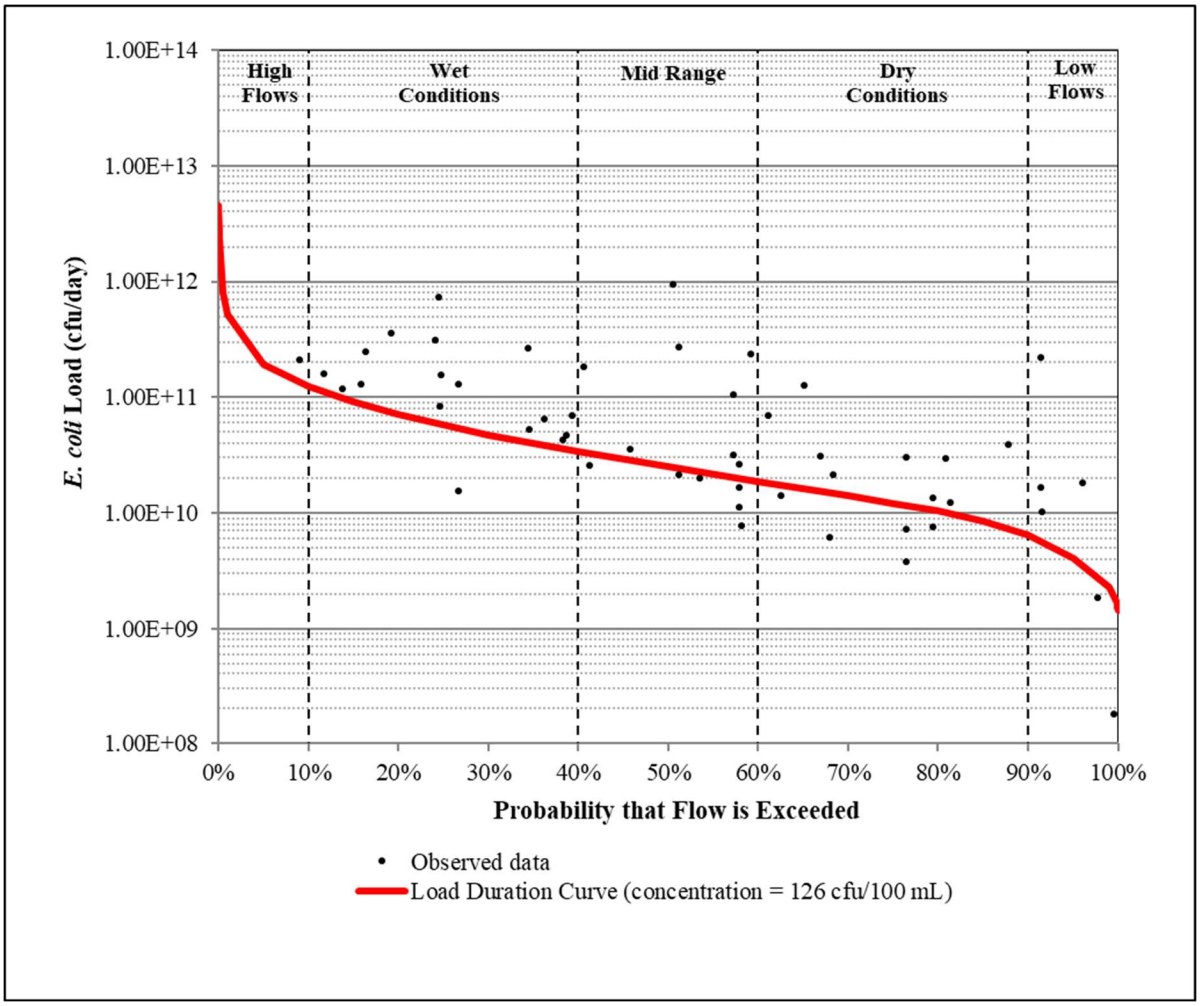

Figure 10. *E. coli* TMDL for Little Lost Creek (WBID 3279)

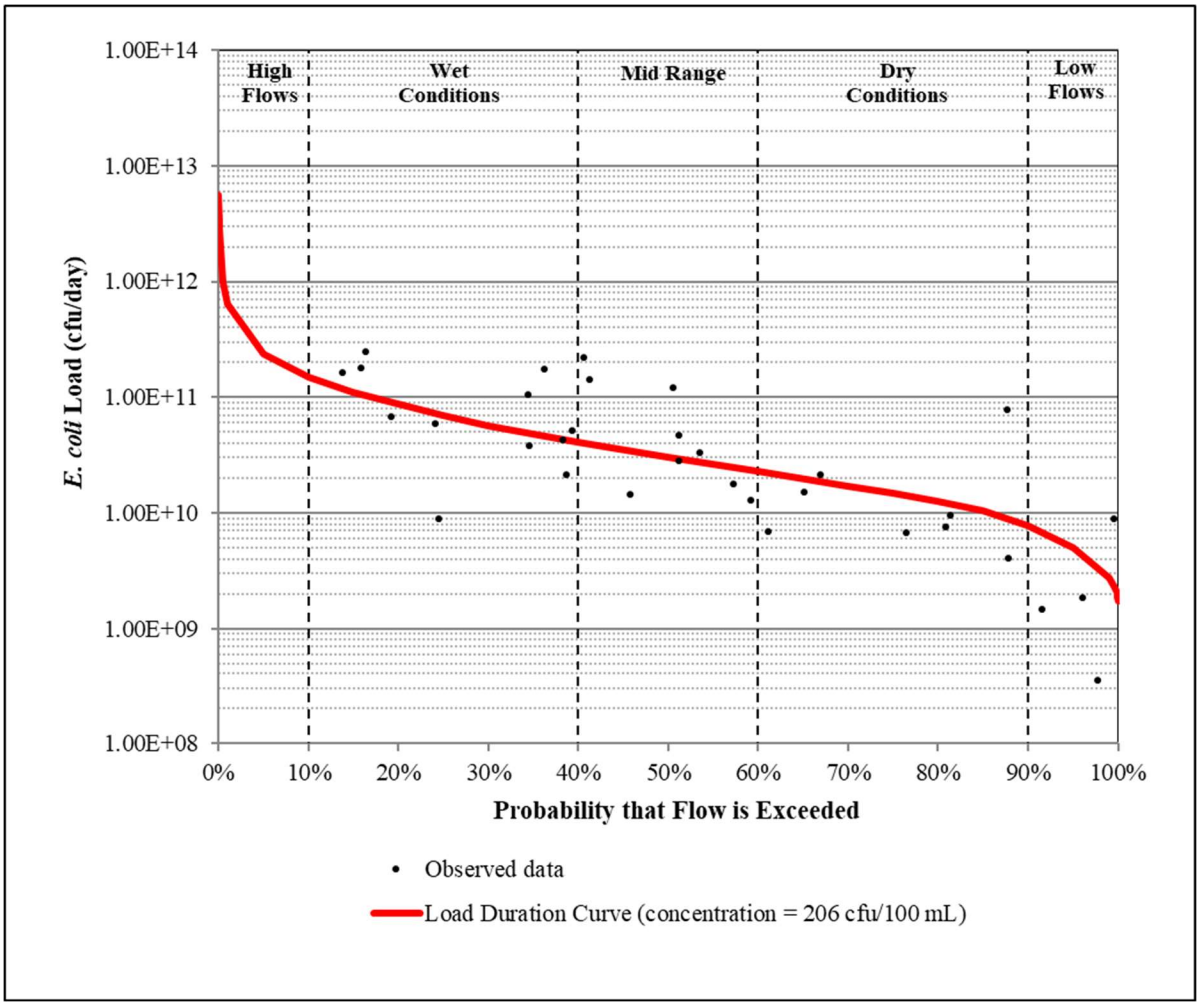

Figure 11. *E. coli* TMDL for Willow Branch (WBID 3280)

8. Wasteload Allocation (Point Source Load)

The wasteload allocation is the portion of the loading capacity assigned to existing or future point sources. Pursuant to 40 CFR 122.44(d)(1)(vii)(B), effluent limits or other permit conditions must be consistent with the assumptions and requirements of TMDL wasteload allocations. For this TMDL no portion of the available loading capacity was allocated to point sources in the watersheds of Lost Creek, Little Lost Creek, or Willow Branch. Specific rationale is provided in the following subsections for each point source type.

It should be noted that the wasteload allocations presented in this TMDL report do not preclude the establishment of future point sources. Any future point sources should be evaluated against the TMDL, the range of flows with which any additional bacterial loading will affect, and any additional requirements associated with antidegradation. Federal regulation 40 CFR 122.4(a), disallows the issuance of a National Pollutant Discharge Elimination System (NPDES) permit if the conditions of the permit cannot provide for compliance with the applicable requirements of the federal Clean Water Act or regulations promulgated under the federal Clean Water Act. Additionally, 40 CFR 122.4(i) states no permit may be issued to a new source or new discharger if the discharge from its construction or operation will cause or contribute to violation of water quality standards. New or expanding facilities that generate *E. coli* but disinfect wastewater prior to

discharge or implement other appropriate measures to reduce *E. coli* from effluent during the recreational season (e.g., no discharge or batch discharge) consistent with applicable permit limits will result in negligible bacteria loading and will be consistent with the assumptions and requirements of the established wasteload allocations. Decommissioning of onsite wastewater treatment systems and connecting to sewerage systems for wastewater treatment will result in net pollutant reductions that are consistent with the goals of this TMDL.

8.1 Domestic Wastewater Treatment Facilities

The 4 State Moto Complex LLC (MO-G823203) is a domestic wastewater treatment facility located in the Willow Branch watershed, which is also contained within the Lost Creek watershed. This facility is not authorized to discharge. Therefore the *E. coli* wasteload allocation for domestic wastewater facilities is zero at all flows.

8.2 Industrial and Commercial Facilities

There are no industrial or domestic dischargers in the Lost Creek watershed. For this reason the *E. coli* wasteload allocation for industrial and commercial facilities is zero at all flows.

8.3 Concentrated Animal Feeding Operations

There are no CAFOs in the Lost Creek watershed. CAFO permits also do not allow discharge to surface waters. For these reasons, the *E. coli* wasteload allocation for CAFOs is zero at all flows.

8.4 Municipal Separate Storm Sewer Systems

Areas potentially contributing stormwater to the City of Neosho's MS4 account for approximately 0.1 percent of the entire Lost Creek watershed. No portion of these areas are contained within the subwatersheds of Little Lost Creek or Willow Branch. Potential loading contributions from the Neosho MS4 are expected to be negligible, and no wasteload allocation was assigned. *E. coli* loading via stormwater runoff from other developed areas is included in the load allocation to nonpoint sources. If the area contributing to the Neosho MS4 expands or additional MS4 permits are required for stormwater discharges from other developed areas in the future, then the appropriate proportion of the load allocation, as it relates to stormwater pollutant contributions, may be re-assigned as a wasteload allocation without revision to this TMDL.

8.5 Other General Permitted Wastewater and Stormwater Discharges

There are no other general or stormwater permitted facilities in the Lost Creek watershed that are expected to contribute *E. coli* concentrations above negligible amounts to surface waters. Permit conditions for these activities are protective of the designated uses assigned to all water bodies in the watershed. Activities for which these permits are issued are expected to be conducted in compliance with all permit conditions, including any land application, monitoring, stormwater pollution prevention plans, and discharge limitations. For these reasons, the *E. coli* wasteload allocations for these facilities are set at existing permit limits and conditions. Future general and stormwater permitted activities that do not actively generate bacteria and that operate in full compliance with permit conditions are not expected to contribute bacteria loads above negligible levels and will not result in loading that exceeds the sum of the TMDL wasteload allocations.

8.6 Illicit Straight Pipe Discharges

Illicit straight pipe discharges are illegal and are not permitted under the federal Clean Water Act. For this reason, illicit straight pipe discharges are not allocated a portion of the available loading

capacity and are assigned an *E. coli* wasteload allocation of zero. Any existing illicit straight pipe discharges must be eliminated and future discharges of this type should be prevented.

9. Load Allocation (Nonpoint Source Load)

The load allocation is the portion of the loading capacity assigned to existing and future nonpoint sources and natural background contributions (40 CFR 130.2(g)). Because no portion of the available loading capacity was assigned as a wasteload allocation, the *E. coli* load allocations are equal to the loading capacity minus an explicit margin of safety as presented in Section 7. The load allocations include contributions from agricultural lands, runoff from developed areas, and natural background contributions. No portion of the load allocations is assigned to onsite wastewater treatment systems because when they are properly maintained and operating as designed they do not discharge *E. coli* directly to surface waters.

10. Margin of Safety

A margin of safety is required to account for uncertainties in scientific and technical understanding of water quality in natural systems (CWA Section 303(d)(l)(C) and 40 CFR 130.7(c)(l)). Based on EPA guidance, the margin of safety can be achieved through two approaches:

- Explicit - Reserve a portion of the loading capacity as a separate term in the TMDL.
- Implicit - Incorporate the margin of safety within the wasteload allocation and the load allocation calculations by making conservative assumptions in the analysis.

An explicit margin of safety equal to 10 percent of the loading capacity is included in the TMDL for Lost Creek, Little Lost Creek, and Willow Branch. Additionally, bacteria decay rates were not applied and the direct recreational-season geometric mean was used for estimating the daily loading value as required by the federal Clean Water Act. These conservative assumptions serve as additional implicit margins of safety. For Little Lost Creek, the loading capacity for the entire water body is based on Missouri's losing stream criterion, even though the criterion is applicable to only the 1.4 miles of the stream identified as losing. This more stringent target provides an implicit margin of safety that recreational uses will be protected in portions of the stream that are not losing.

11. Seasonal Variation

Federal regulations at 40 CFR 130.7(c)(1) require that TMDLs take into consideration seasonal variation in applicable water quality standards. The load duration curves provide the *E. coli* loading capacities for each water body at all possible flow regimes using data collected during all seasons. The *E. coli* TMDLs are therefore protective of designated uses during critical conditions throughout the recreational season, including during high flows associated with intense rainfall events when bacteria loading is more likely.

12. Monitoring Plans

The Department conducts water quality monitoring in impaired waters within a reasonable timeframe following the approval of TMDLs, completion of any facility upgrades and permit compliance schedules, or the implementation of watershed BMPs. The Department will also routinely examine any available quality-assured water quality data collected by other local, state, and federal entities in order to assess the effectiveness of TMDL implementation. In addition, certain quality-assured data collected by universities, municipalities, private companies, and volunteer groups may be used to assess water quality following TMDL implementation.

13. Reasonable Assurance

Section 303(d)(1)(C) of the federal Clean Water Act requires that TMDLs be established at a level necessary to implement applicable water quality standards. As part of the TMDL process, consideration must be given to the assurances that point and nonpoint source allocations will be achieved and water quality standards attained. Where TMDLs are developed for waters impaired by point sources only, reasonable assurance is provided through the NPDES permitting program. State operating permits requiring effluent monitoring be reported to the Department provide reasonable assurance that instream water quality standards will be met.

Where a TMDL is developed for waters impaired by both point and nonpoint sources, point source wasteload allocations must be stringent enough so that in conjunction with the water body's other loadings (i.e., nonpoint sources) water quality standards are met. Reasonable assurance that nonpoint sources will meet their allocated amount is dependent upon the availability and implementation of nonpoint source pollutant reduction plans, controls, or BMPs within the watershed. If BMPs or other nonpoint source pollution controls allow for more stringent load allocations, then wasteload allocations can be less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs (40 CFR 130.2(i)). When a demonstration of nonpoint source reasonable assurance is developed for an impaired water body, additional pollutant allocations for point sources may be allowed provided water quality standards are still attained. If a demonstration of nonpoint source reasonable assurance does not exist, or it is determined that nonpoint source pollutant reduction plans, controls, or BMPs are not feasible, durable, or will not result in the required load reductions, then allocation of greater pollutant loading to point sources cannot occur.

A variety of grants and loans may be available to assist watershed stakeholders with developing and implementing watershed based plans, controls, and practices to meet the required wasteload and load allocations in the TMDL and demonstrate reasonable assurance. Information regarding potential funding sources, cost-share opportunities, and implementation actions that address nonpoint source loading in the Lost Creek, Little Lost Creek, and Willow Branch watersheds are provided in the supplemental TMDL Implementation Strategies document available online at dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/tmdls.

14. Public Participation

EPA regulations at 40 CFR 130.7 require that TMDLs be subject to public review. A 45-day public notice period for this TMDL report was scheduled from August 12, 2022 through September 26, 2022.Groups that directly received notice of the public comment period for this TMDL include, but are not limited to:

- Missouri Clean Water Commission;
- Missouri Department of Conservation;
- Southwest Regional Office;
- Harry S Truman Coordinating Council;
- Newton County Soil and Water Conservation District;
- Newton County health department;
- Newton County commission;
- University of Missouri Extension;

- Missouri Coalition for the Environment;
- Stream Teams United;
- Stream Team volunteers living in or near the watershed; and
- Missouri state legislators representing areas within the watershed.

In addition to those groups directly contacted about the public notice, this TMDL report and an implementation strategies document are posted on the Department's TMDL webpage at dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/tmdls. All comments received during this period and the Department's responses to those comments are also available at this location.

The Department maintains an email distribution list for notifying subscribers of significant TMDL updates or activities, including public notices and comment periods. Those interested in subscribing to TMDL updates can submit their email address using the online form available at public.govdelivery.com/accounts/MODNR/subscriber/new?topic_id=MODNR_177.

15. Administrative Record and Supporting Documentation

The Department has an administrative record on file for the Lost Creek *E. coli* TMDL. The record contains plans, studies, and other information on which the TMDL is based. It additionally includes the TMDL implementation strategies document, the public notice announcement, any public comments received, and the Department's responses to those comments. This information is available upon request to the Department at dnr.mo.gov/open-records-sunshine-law-requests. The Department will process any request for information about this TMDL in accordance with Missouri's Sunshine Law (Chapter 610, RSMo) and the Department's administrative policies and procedures governing Sunshine Law requests.

16. References

Arnold, C.L. and C.J. Gibbons. 1996. Impervious surface coverage: the emergence of a key environmental indicator. Journal of the American Planning Association 62.2

Brown, E., Caraco, D. and R. Pitt. 2004. Illicit discharge detection and elimination a guidance manual for program development and technical assessments. EPA X-82907801-0

Burton, A.G. Jr. and R.E. Pitt. 2002. Stormwater effects handbook, a toolbox for watershed managers, scientists, and engineers. ISBN 0-87371-924-7 New York: CRC Press.

Chapman, S.S., Omernik, J.M., Griffith, G.E., Schroeder, W.A., Nigh, T.A., and Wilton, T.F. 2002. Ecoregions of Iowa and Missouri (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,800,000).

Davis, J. V., & Barr, M. N. 2006. Assessment of possible sources of microbiological contamination in the water column and streambed sediment of the Jacks Fork, Ozark National Scenic Riverways, Missouri--phase III. US Geological Survey.

Dewitz, J., 2021, National Land Cover Database (NLCD) 2019 Products: U.S. Geological Survey data release, https://doi.org/10.5066/P96HHBIE. Available URL: https://www.mrlc.gov/viewer/ [Accessed 15 November 2021].

DHSS (Missouri Department of Health and Senior Services). 2018. Onsite wastewater treatment webpage. [Online WWW] Available URL: health.mo.gov/living/environment/onsite/ [Accessed 15 November 2021].

EPRI (Electric Power Research Institute). 2000. Advanced on-site wastewater treatment and management market study: volume 2.

Federal Geographic Data Committee (FGDC). 2003. FGDC Proposal, Version 1.1, Federal standards for delineation of hydrologic unit boundaries. December 23, 2003.

Horsley & Witten, Inc. 1996. Identification and evaluation of nutrient and bacterial loadings to Maquoit Bay, Brunswick, and Freeport, Maine.

Ishii, S., Hansen D., Hicks, R. and Sadowsky, M. 2007. Beach sand and sediments are temporal sinks and sources of *Escherichia coli* in Lake Superior. Environ Sci Technol 41, 2203 – 2209.

Marino, R. P., & Gannon, J. J. 1991. Survival of fecal coliforms and fecal streptococci in storm drain sediment. *Water research*, *25*(9), 1089-1098.

MDC (Missouri Department of Conservation). 2021. Deer Harvest Summaries. [Online WWW] Available URL: https://huntfish.mdc.mo.gov/hunting-trapping/species/deer/deer-harvest-reports/deer-harvest-summaries [Accessed 22 November 2021].

MoRAP (Missouri Resource Assessment Partnership). 2005. A gap analysis for riverine ecosystems of Missouri. Final report, submitted to the USGS national gap analysis program. 1675pp.

Nash, J.E. & Sutcliffe, J.V. 1970. River Flow Forecasting through Conceptual Model. Part 1—A Discussion of Principles. Journal of Hydrology, 10, 282-290. http://dx.doi.org/10.1016/0022-1694(70)90255-6

NASS (National Agricultural Statistics Service) USDA. 2017. NASS online agricultural statistics data. [Online WWW] Available URL: https://www.nass.usda.gov/Publications/AgCensus/2017/index.php [Accessed 16 November 2021].

NOAA (National Oceanic and Atmospheric Administration). 2020. NOAA National Centers for Environmental Information, Data Tools 1991-2020 Normals. [Online WWW] Available URL: https://www.ncei.noaa.gov/access/us-climate-normals/ [Accessed 1 Oct. 2021].

NRCS (Natural Resources Conservation Service). 2009. National Engineering Handbook, Part 630 Hydrology, Chapter 7 Hydrologic Soil Groups.

NRCS (Natural Resources Conservation Service). 2020. Soil Survey Geographic Database (SSURGO) for Missouri. [Computer file].

Rogers, Shane and John Haines. 2005. Detecting and mitigating the environmental impact of fecal pathogens originating from confined animal feeding operations: Review. EPA/600/R-06/021.

Schueler, Tom. 1994. The importance of imperviousness. Watershed Protection Techniques. 1.3

Sutton, Alan L. 1990. Animal agriculture's effect on water quality pastures and feedlots. WQ-7. Purdue University Extension. [Online WWW]. Available URL: https://www.extension.purdue.edu/extmedia/wq/wq-7.html [Accessed 14 Dec. 2021].

U.S. Census Bureau (U.S. Department of Commerce). 2020. TIGER/Line Shapefile, 2020, 2020 state, Missouri, 2020 Census Block State-based [ArcView Shapefile].

USDA (U.S. Department of Agriculture). 1995. Animal manure management – RCA Issue Brief #7. [Online WWW] Available URL: nrcs.usda.gov/wps/portal/nrcs/detail/null/?cid=nrcs143_014211 [Accessed 14 December 2021].

USEPA (U.S. Environmental Protection Agency). 1983. Results of the nationwide urban runoff program – Executive Summary PB84-185545.

USEPA (U.S. Environmental Protection Agency). 1986. Design manual – municipal wastewater disinfection. EPA/625/1-86/021

USEPA (U.S. Environmental Protection Agency). 2006. Establishing TMDL "daily" loads in light of the decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al., No. 05-5015, (April 25, 2006), and implications for NPDES Permits. [Online WWW] Available URL: www.epa.gov/tmdl/impaired-waters-and-tmdls-tmdl-information-and-support-documents [Accessed 14 May 2021].

USEPA (U.S. Environmental Protection Agency). 2007a. Options for expressing daily loads in TMDLs. Office of Wetlands, Oceans & Watersheds. June 22, 2007.

USEPA (U.S. Environmental Protection Agency). 2007b. An approach for using load duration curves in the development of TMDLs. EPA 841-B-07-006.

USEPA (U.S. Environmental Protection Agency). 2014a. Environmental justice? [Online WWW] Available URL: www.epa.gov/environmentaljustice [Accessed 14 December 2021].

USEPA (U.S. Environmental Protection Agency). 2014b. STEPL data server for sample input data. [Online WWW] Available URL: https://ordspub.epa.gov/ords/grts/f?p=109:333 [Accessed 14 December 2021].

USGS (U.S. Geological Survey). 2010. Estimated Use of Water in the United States in 2010. Geological Survey Circular 1405, 56 p.,https://doi.org/10.3133/cir1405

USGS (U.S. Geological Survey) and NRCS (Natural Resources Conservation Service). 2013. Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD) (4th ed): US Geological Survey Techniques and Methods 11-A3, 63p. Available URL: pubs.usgs.gov/tm/11/a3/

USGS (U.S. Geological Survey). 2019. Hydrologic unit maps. [Online WWW] Available URL: https://water.usgs.gov/GIS/huc.html [Accessed 14 December 2021].

Appendix A

Table A-1. Available *E. coli* data for Lost Creek (3278), Little Lost Creek (3279), and Willow Branch (3280)

Water Body	Org.	Site Description	Sample ID	Site Code	Date	E. coli (cfu/100 mL)
3278	ESTO	Lost Cr. @ State Line, Seneca	49	3278/0	10/1/2004	225.4
3278	ESTO	Lost Cr. Below Seneca WWTP	1	3278/-0.8	10/1/2004	224.7
3278	ESTO	Lost Cr. @ State Line, Seneca	55	3278/0	4/1/2005	517.2
3278	ESTO	Lost Cr. @ State Line, Seneca	56	3278/0	5/1/2005	547.5
3278	ESTO	Lost Cr. @ State Line, Seneca	57	3278/0	6/1/2005	478.6
3278	ESTO	Lost Cr. @ State Line, Seneca	58	3278/0	7/1/2005	4839.2
3278	ESTO	Lost Cr. @ State Line, Seneca	59	3278/0	8/1/2005	32.1
3278	ESTO	Lost Cr. @ State Line, Seneca	60	3278/0	9/1/2005	378.4
3278	ESTO	Lost Cr. @ State Line, Seneca	61	3278/0	10/18/2005	686.7
3278	NCHD	Lost Cr. @ Seneca	370	3278/0.4	6/9/2005	133.6
3278	NCHD	Lost Cr. @ Seneca	371	3278/0.4	7/12/2005	196.8
3278	ESTO	Lost Cr. Below Seneca WWTP	7	3278/-0.8	4/1/2005	151.0
3278	ESTO	Lost Cr. Below Seneca WWTP	8	3278/-0.8	5/1/2005	268.2
3278	ESTO	Lost Cr. Below Seneca WWTP	9	3278/-0.8	6/1/2005	168.6
3278	ESTO	Lost Cr. Below Seneca WWTP	10	3278/-0.8	7/1/2005	4839.2
3278	ESTO	Lost Cr. Below Seneca WWTP	11	3278/-0.8	8/1/2005	62.0
3278	ESTO	Lost Cr. Below Seneca WWTP	12	3278/-0.8	9/1/2005	547.5
3278	ESTO	Lost Cr. Below Seneca WWTP	13	3278/-0.8	10/18/2005	387.3
3278	NCHD	Lost Cr. @ Hwy K	396	3278/4.5	6/14/2005	259.5
3278	NCHD	Lost Cr. @ Hwy K	397	3278/4.5	7/13/2005	248.9
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	446	3278/7.0	6/14/2005	517.2
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	447	3278/7.0	7/13/2005	235.9
3278	ESTO	Lost Cr. @ State Line, Seneca	67	3278/0	4/19/2006	14.2
3278	ESTO	Lost Cr. @ State Line, Seneca	68	3278/0	5/23/2006	177.7
3278	ESTO	Lost Cr. @ State Line, Seneca	69	3278/0	6/13/2006	64.1
3278	ESTO	Lost Cr. @ State Line, Seneca	70	3278/0	7/24/2006	14.2
3278	ESTO	Lost Cr. @ State Line, Seneca	71	3278/0	8/21/2006	20.2
3278	ESTO	Lost Cr. @ State Line, Seneca	72	3278/0	9/5/2006	59.2
3278	ESTO	Lost Cr. @ State Line, Seneca	73	3278/0	10/18/2006	157.6
3278	ESTO	Lost Cr. Below Seneca WWTP	19	3278/-0.8	4/19/2006	26.9
3278	ESTO	Lost Cr. Below Seneca WWTP	20	3278/-0.8	5/23/2006	154.1
3278	ESTO	Lost Cr. Below Seneca WWTP	21	3278/-0.8	6/13/2006	48.1
3278	ESTO	Lost Cr. Below Seneca WWTP	22	3278/-0.8	7/24/2006	21.8
3278	ESTO	Lost Cr. Below Seneca WWTP	23	3278/-0.8	8/21/2006	24.6
3278	ESTO	Lost Cr. Below Seneca WWTP	24	3278/-0.8	9/5/2006	61.3
3278	ESTO	Lost Cr. Below Seneca WWTP	25	3278/-0.8	10/18/2006	38.8
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	448	3278/7.0	5/25/2006	4839.2
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	449	3278/7.0	6/6/2006	4839.2
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	450	3278/7.0	6/20/2006	235.9
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	451	3278/7.0	6/27/2006	150.0
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	452	3278/7.0	7/11/2006	1413.6
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	453	3278/7.0	7/19/2006	488.4
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	454	3278/7.0	7/26/2006	166.4
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	455	3278/7.0	8/2/2006	167.0
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	456	3278/7.0	8/10/2006	344.1
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	457	3278/7.0	8/16/2006	1986.3
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	458	3278/7.0	8/23/2006	185.0
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	459	3278/7.0	8/30/2006	275.5
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	460	3278/7.0	9/5/2006	166.4
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	461	3278/7.0	9/12/2006	198.9
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	462	3278/7.0	9/19/2006	228.2
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	463	3278/7.0	9/26/2006	172.5
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	464	3278/7.0	10/3/2006	424.2

Water Body	Org.	Site Description	Sample ID	Site Code	Date	E. coli (cfu/100 mL)
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	465	3278/7.0	10/18/2006	124.6
3278	ESTO	Lost Cr. @ State Line, Seneca	79	3278/0	4/18/2007	222.4
3278	ESTO	Lost Cr. @ State Line, Seneca	80	3278/0	5/2/2007	222.4
3278	ESTO	Lost Cr. @ State Line, Seneca	81	3278/0	5/4/2007	1413.6
3278	ESTO	Lost Cr. @ State Line, Seneca	82	3278/0	5/9/2007	980.4
3278	ESTO	Lost Cr. @ State Line, Seneca	83	3278/0	5/11/2007	547.5
3278	ESTO	Lost Cr. @ State Line, Seneca	84	3278/0	5/16/2007	1553.1
3278	ESTO	Lost Cr. @ State Line, Seneca	85	3278/0	5/18/2007	20.2
3278	ESTO	Lost Cr. @ State Line, Seneca	86	3278/0	5/22/2007	16.8
3278	ESTO	Lost Cr. @ State Line, Seneca	87	3278/0	5/23/2007	188.2
3278	ESTO	Lost Cr. @ State Line, Seneca	88	3278/0	5/24/2007	188.2
3278	ESTO	Lost Cr. @ State Line, Seneca	89	3278/0	5/30/2007	517.2
3278	ESTO	Lost Cr. @ State Line, Seneca	90	3278/0	6/1/2007	435.2
3278	ESTO	Lost Cr. @ State Line, Seneca	91	3278/0	6/5/2007	83.5
3278	ESTO	Lost Cr. @ State Line, Seneca	92	3278/0	6/7/2007	27.8
3278	ESTO	Lost Cr. @ State Line, Seneca	93	3278/0	6/19/2007	114.5
3278	ESTO	Lost Cr. @ State Line, Seneca	94	3278/0	6/21/2007	206.4
3278	ESTO	Lost Cr. @ State Line, Seneca	95	3278/0	6/26/2007	31.5
3278	ESTO	Lost Cr. @ State Line, Seneca	96	3278/0	6/27/2007	31.5
3278	ESTO	Lost Cr. @ State Line, Seneca	97	3278/0	6/28/2007	48.9
3278	ESTO	Lost Cr. @ State Line, Seneca	98	3278/0	7/3/2007	82.3
3278	ESTO	Lost Cr. @ State Line, Seneca	99	3278/0	7/6/2007	42.2
3278	ESTO	Lost Cr. @ State Line, Seneca	100	3278/0	7/12/2007	31.8
3278	ESTO	Lost Cr. @ State Line, Seneca	101	3278/0	7/17/2007	55.2
3278	ESTO	Lost Cr. @ State Line, Seneca	102	3278/0	7/20/2007	118.7
3278	ESTO	Lost Cr. @ State Line, Seneca	103	3278/0	7/24/2007	27.5
3278	ESTO	Lost Cr. @ State Line, Seneca	104	3278/0	7/26/2007	32.3
3278	ESTO	Lost Cr. @ State Line, Seneca	105	3278/0	7/31/2007	172.5
3278	ESTO	Lost Cr. @ State Line, Seneca	106	3278/0	8/2/2007	214.2
3278	ESTO	Lost Cr. @ State Line, Seneca	107	3278/0	8/7/2007	71.4
3278	ESTO	Lost Cr. @ State Line, Seneca	108	3278/0	8/9/2007	51.2
3278	ESTO	Lost Cr. @ State Line, Seneca	109	3278/0	8/14/2007	89.2
3278	ESTO	Lost Cr. @ State Line, Seneca	110	3278/0	8/16/2007	13.9
3278	ESTO	Lost Cr. @ State Line, Seneca	111	3278/0	8/20/2007	143.0
3278	ESTO	Lost Cr. @ State Line, Seneca	112	3278/0	8/22/2007	47.4
3278	ESTO	Lost Cr. @ State Line, Seneca	113	3278/0	8/27/2007	107.1
3278	ESTO	Lost Cr. @ State Line, Seneca	114	3278/0	8/29/2007	35.4
3278	ESTO	Lost Cr. @ State Line, Seneca	115	3278/0	9/4/2007	27.8
3278	ESTO	Lost Cr. @ State Line, Seneca	116	3278/0	9/6/2007	218.7
3278	ESTO	Lost Cr. @ State Line, Seneca	117	3278/0	9/10/2007	193.5
3278	ESTO	Lost Cr. @ State Line, Seneca	118	3278/0	9/12/2007	40.5
3278	ESTO	Lost Cr. @ State Line, Seneca	119	3278/0	9/17/2007	66.3
3278	ESTO	Lost Cr. @ State Line, Seneca	120	3278/0	9/24/2007	49.6
3278	ESTO	Lost Cr. @ State Line, Seneca	121	3278/0	9/26/2007	52.8
3278	ESTO	Lost Cr. @ State Line, Seneca	122	3278/0	10/16/2007	235.9
3278	NCHD	Lost Cr. @ Seneca	372	3278/0.4	4/3/2007	307.6
3278	NCHD	Lost Cr. @ Seneca	373	3278/0.4	4/10/2007	307.6
3278	NCHD	Lost Cr. @ Seneca	374	3278/0.4	4/17/2007	183.5
3278	NCHD	Lost Cr. @ Seneca	375	3278/0.4	4/24/2007	218.7
3278	NCHD	Lost Cr. @ Seneca	376	3278/0.4	5/1/2007	435.2
3278	NCHD	Lost Cr. @ Seneca	377	3278/0.4	5/9/2007	365.4
3278	NCHD	Lost Cr. @ Seneca	378	3278/0.4	5/15/2007	290.9
3278	NCHD	Lost Cr. @ Seneca	379	3278/0.4	5/23/2007	131.7
3278	NCHD	Lost Cr. @ Seneca	380	3278/0.4	5/29/2007	488.4
3278	NCHD	Lost Cr. @ Seneca	381	3278/0.4	6/6/2007	231.0
3278	NCHD	Lost Cr. @ Seneca	382	3278/0.4	6/20/2007	185.0
3278	NCHD	Lost Cr. @ Seneca	383	3278/0.4	7/5/2007	50.4
3278	NCHD	Lost Cr. @ Seneca	384	3278/0.4	7/10/2007	172.5
3278	NCHD	Lost Cr. @ Seneca	385	3278/0.4	7/17/2007	167.0
3278	NCHD	Lost Cr. @ Seneca	386	3278/0.4	7/24/2007	35.9

Water Body	Org.	Site Description	Sample ID	Site Code	Date	E. coli (cfu/100 mL)
3278	NCHD	Lost Cr. @ Seneca	387	3278/0.4	7/31/2007	185.0
3278	NCHD	Lost Cr. @ Seneca	388	3278/0.4	8/7/2007	344.1
3278	NCHD	Lost Cr. @ Seneca	389	3278/0.4	8/14/2007	42.2
3278	NCHD	Lost Cr. @ Seneca	390	3278/0.4	8/21/2007	101.4
3278	NCHD	Lost Cr. @ Seneca	391	3278/0.4	8/28/2007	39.0
3278	NCHD	Lost Cr. @ Seneca	392	3278/0.4	9/4/2007	101.7
3278	NCHD	Lost Cr. @ Seneca	393	3278/0.4	9/11/2007	72.4
3278	NCHD	Lost Cr. @ Seneca	394	3278/0.4	9/18/2007	48.0
3278	NCHD	Lost Cr. @ Seneca	395	3278/0.4	9/25/2007	56.3
3278	ESTO	Lost Cr. Below Seneca WWTP	31	3278/-0.8	4/18/2007	93.3
3278	ESTO	Lost Cr. Below Seneca WWTP	32	3278/-0.8	5/23/2007	58.5
3278	ESTO	Lost Cr. Below Seneca WWTP	33	3278/-0.8	6/26/2007	24.5
3278	ESTO	Lost Cr. Below Seneca WWTP	34	3278/-0.8	7/17/2007	80.1
3278	ESTO	Lost Cr. Below Seneca WWTP	35	3278/-0.8	8/14/2007	104.3
3278	ESTO	Lost Cr. Below Seneca WWTP	36	3278/-0.8	9/12/2007	2419.6
3278	ESTO	Lost Cr. Below Seneca WWTP	37	3278/-0.8	10/16/2007	105.0
3278	NCHD	Lost Cr. @ Hwy K	398	3278/4.5	4/3/2007	727.0
3278	NCHD	Lost Cr. @ Hwy K	399	3278/4.5	4/10/2007	461.1
3278	NCHD	Lost Cr. @ Hwy K	400	3278/4.5	4/17/2007	290.9
3278	NCHD	Lost Cr. @ Hwy K	401	3278/4.5	4/24/2007	416.0
3278	NCHD	Lost Cr. @ Hwy K	402	3278/4.5	5/1/2007	285.1
3278	NCHD	Lost Cr. @ Hwy K	403	3278/4.5	5/9/2007	387.3
3278	NCHD	Lost Cr. @ Hwy K	404	3278/4.5	5/15/2007	238.2
3278	NCHD	Lost Cr. @ Hwy K	405	3278/4.5	5/23/2007	93.4
3278	NCHD	Lost Cr. @ Hwy K	406	3278/4.5	5/29/2007	727.0
3278	NCHD	Lost Cr. @ Hwy K	407	3278/4.5	6/6/2007	122.3
3278	NCHD	Lost Cr. @ Hwy K	408	3278/4.5	6/20/2007	204.6
3278	NCHD	Lost Cr. @ Hwy K	409	3278/4.5	7/5/2007	81.6
3278	NCHD	Lost Cr. @ Hwy K	410	3278/4.5	7/10/2007	101.9
3278	NCHD	Lost Cr. @ Hwy K	411	3278/4.5	7/17/2007	142.1
3278	NCHD	Lost Cr. @ Hwy K	412	3278/4.5	7/24/2007	81.3
3278	NCHD	Lost Cr. @ Hwy K	413	3278/4.5	7/31/2007	50.4
3278	NCHD	Lost Cr. @ Hwy K	414	3278/4.5	8/7/2007	325.5
3278	NCHD	Lost Cr. @ Hwy K	415	3278/4.5	8/14/2007	82.3
3278	NCHD	Lost Cr. @ Hwy K	416	3278/4.5	8/21/2007	61.0
3278	NCHD	Lost Cr. @ Hwy K	417	3278/4.5	8/28/2007	156.5
3278	NCHD	Lost Cr. @ Hwy K	418	3278/4.5	9/4/2007	114.5
3278	NCHD	Lost Cr. @ Hwy K	419	3278/4.5	9/11/2007	90.6
3278	NCHD	Lost Cr. @ Hwy K	420	3278/4.5	9/18/2007	172.6
3278	NCHD	Lost Cr. @ Hwy K	421	3278/4.5	9/25/2007	46.4
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	466	3278/7.0	4/3/2007	290.9
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	467	3278/7.0	4/10/2007	290.9
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	468	3278/7.0	4/17/2007	344.8
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	469	3278/7.0	4/24/2007	435.2
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	470	3278/7.0	5/1/2007	461.1
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	471	3278/7.0	5/9/2007	816.4
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	472	3278/7.0	5/15/2007	325.5
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	473	3278/7.0	5/23/2007	156.5
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	474	3278/7.0	5/29/2007	410.6
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	475	3278/7.0	6/6/2007	161.6
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	476	3278/7.0	6/20/2007	142.1
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	477	3278/7.0	7/5/2007	111.9
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	478	3278/7.0	7/10/2007	365.4
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	479	3278/7.0	7/17/2007	98.5
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	480	3278/7.0	7/24/2007	52.9
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	481	3278/7.0	7/31/2007	143.9
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	482	3278/7.0	8/7/2007	154.2
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	483	3278/7.0	8/14/2007	145.0
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	484	3278/7.0	8/21/2007	84.0
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	485	3278/7.0	8/28/2007	290.9

Water Body	Org.	Site Description	Sample ID	Site Code	Date	E. coli (cfu/100 mL)
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	486	3278/7.0	9/4/2007	135.4
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	487	3278/7.0	9/11/2007	261.3
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	488	3278/7.0	9/18/2007	228.2
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	489	3278/7.0	9/25/2007	145.0
3278	ESTO	Lost Cr. @ State Line, Seneca	128	3278/0	4/23/2008	88.6
3278	ESTO	Lost Cr. @ State Line, Seneca	129	3278/0	5/6/2008	206.4
3278	ESTO	Lost Cr. @ State Line, Seneca	130	3278/0	5/13/2008	75.1
3278	ESTO	Lost Cr. @ State Line, Seneca	131	3278/0	5/15/2008	658.6
3278	ESTO	Lost Cr. @ State Line, Seneca	132	3278/0	5/20/2008	125.4
3278	ESTO	Lost Cr. @ State Line, Seneca	133	3278/0	5/22/2008	193.5
3278	ESTO	Lost Cr. @ State Line, Seneca	134	3278/0	5/29/2008	210.5
3278	ESTO	Lost Cr. @ State Line, Seneca	135	3278/0	6/3/2008	410.6
3278	ESTO	Lost Cr. @ State Line, Seneca	136	3278/0	6/5/2008	69.3
3278	ESTO	Lost Cr. @ State Line, Seneca	137	3278/0	6/12/2008	111.9
3278	ESTO	Lost Cr. @ State Line, Seneca	138	3278/0	6/19/2008	148.3
3278	ESTO	Lost Cr. @ State Line, Seneca	139	3278/0	6/24/2008	131.4
3278	ESTO	Lost Cr. @ State Line, Seneca	140	3278/0	6/25/2008	178.5
3278	ESTO	Lost Cr. @ State Line, Seneca	141	3278/0	7/1/2008	154.1
3278	ESTO	Lost Cr. @ State Line, Seneca	142	3278/0	7/2/2008	129.6
3278	ESTO	Lost Cr. @ State Line, Seneca	143	3278/0	7/8/2008	233.3
3278	ESTO	Lost Cr. @ State Line, Seneca	144	3278/0	7/10/2008	328.2
3278	ESTO	Lost Cr. @ State Line, Seneca	145	3278/0	7/15/2008	56.7
3278	ESTO	Lost Cr. @ State Line, Seneca	146	3278/0	7/17/2008	135.4
3278	ESTO	Lost Cr. @ State Line, Seneca	147	3278/0	7/22/2008	178.5
3278	ESTO	Lost Cr. @ State Line, Seneca	148	3278/0	7/25/2008	190.4
3278	ESTO	Lost Cr. @ State Line, Seneca	149	3278/0	7/29/2008	313.0
3278	ESTO	Lost Cr. @ State Line, Seneca	150	3278/0	8/5/2008	66.3
3278	ESTO	Lost Cr. @ State Line, Seneca	151	3278/0	8/7/2008	4839.2
3278	ESTO	Lost Cr. @ State Line, Seneca	152	3278/0	8/12/2008	272.3
3278	ESTO	Lost Cr. @ State Line, Seneca	153	3278/0	8/15/2008	103.6
3278	ESTO	Lost Cr. @ State Line, Seneca	154	3278/0	8/19/2008	218.7
3278	ESTO	Lost Cr. @ State Line, Seneca	155	3278/0	8/21/2008	166.4
3278	ESTO	Lost Cr. @ State Line, Seneca	156	3278/0	8/26/2008	178.5
3278	ESTO	Lost Cr. @ State Line, Seneca	157	3278/0	8/27/2008	238.2
3278	ESTO	Lost Cr. @ State Line, Seneca	158	3278/0	9/2/2008	228.2
3278	ESTO	Lost Cr. @ State Line, Seneca	159	3278/0	9/4/2008	357.8
3278	ESTO	Lost Cr. @ State Line, Seneca	160	3278/0	9/9/2008	128.1
3278	ESTO	Lost Cr. @ State Line, Seneca	161	3278/0	9/11/2008	260.3
3278	ESTO	Lost Cr. @ State Line, Seneca	162	3278/0	9/17/2008	325.5
3278	ESTO	Lost Cr. @ State Line, Seneca	163	3278/0	9/18/2008	95.9
3278	ESTO	Lost Cr. @ State Line, Seneca	164	3278/0	9/23/2008	116.0
3278	ESTO	Lost Cr. @ State Line, Seneca	165	3278/0	9/24/2008	60.2
3278	ESTO	Lost Cr. @ State Line, Seneca	223135	3278/0	10/14/2008	91.1
3278	ESTO	Lost Cr. Below Seneca WWTP	43	3278/-0.8	4/23/2008	110.6
3278	ESTO	Lost Cr. Below Seneca WWTP	44	3278/-0.8	5/29/2008	130.1
3278	ESTO	Lost Cr. Below Seneca WWTP	45	3278/-0.8	6/24/2008	37.3
3278	ESTO	Lost Cr. Below Seneca WWTP	46	3278/-0.8	7/22/2008	45.7
3278	ESTO	Lost Cr. Below Seneca WWTP	47	3278/-0.8	8/27/2008	6.3
3278	ESTO	Lost Cr. @ State Line, Seneca	223141	3278/0	4/28/2009	225.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223142	3278/0	5/6/2009	488.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223143	3278/0	5/13/2009	420.8
3278	ESTO	Lost Cr. @ State Line, Seneca	223144	3278/0	5/21/2009	54.8
3278	ESTO	Lost Cr. @ State Line, Seneca	223145	3278/0	5/22/2009	48.9
3278	ESTO	Lost Cr. @ State Line, Seneca	223146	3278/0	5/26/2009	360.9
3278	ESTO	Lost Cr. @ State Line, Seneca	223147	3278/0	5/27/2009	360.9
3278	ESTO	Lost Cr. @ State Line, Seneca	223148	3278/0	5/29/2009	307.6
3278	ESTO	Lost Cr. @ State Line, Seneca	223149	3278/0	6/3/2009	689.3
3278	ESTO	Lost Cr. @ State Line, Seneca	223150	3278/0	6/5/2009	290.9
3278	ESTO	Lost Cr. @ State Line, Seneca	223151	3278/0	6/10/2009	727.0
3278	ESTO	Lost Cr. @ State Line, Seneca	223152	3278/0	6/12/2009	517.2

Water Body	Org.	Site Description	Sample ID	Site Code	Date	E. coli (cfu/100 mL)
3278	ESTO	Lost Cr. @ State Line, Seneca	223153	3278/0	6/16/2009	435.2
3278	ESTO	Lost Cr. @ State Line, Seneca	223154	3278/0	6/18/2009	648.9
3278	ESTO	Lost Cr. @ State Line, Seneca	223155	3278/0	6/23/2009	517.2
3278	ESTO	Lost Cr. @ State Line, Seneca	223156	3278/0	6/24/2009	517.2
3278	ESTO	Lost Cr. @ State Line, Seneca	223157	3278/0	6/26/2009	313.0
3278	ESTO	Lost Cr. @ State Line, Seneca	223158	3278/0	6/30/2009	113.0
3278	ESTO	Lost Cr. @ State Line, Seneca	223159	3278/0	7/2/2009	117.8
3278	ESTO	Lost Cr. @ State Line, Seneca	223160	3278/0	7/8/2009	44.8
3278	ESTO	Lost Cr. @ State Line, Seneca	223161	3278/0	7/10/2009	387.3
3278	ESTO	Lost Cr. @ State Line, Seneca	223162	3278/0	7/15/2009	2419.6
3278	ESTO	Lost Cr. @ State Line, Seneca	223163	3278/0	7/17/2009	218.7
3278	ESTO	Lost Cr. @ State Line, Seneca	223164	3278/0	7/22/2009	1299.7
3278	ESTO	Lost Cr. @ State Line, Seneca	223165	3278/0	7/23/2009	98.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223166	3278/0	7/24/2009	98.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223167	3278/0	7/29/2009	0
3278	ESTO	Lost Cr. @ State Line, Seneca	223168	3278/0	7/31/2009	0
3278	ESTO	Lost Cr. @ State Line, Seneca	223169	3278/0	8/10/2009	199.3
3278	ESTO	Lost Cr. @ State Line, Seneca	223171	3278/0	8/12/2009	62.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223170	3278/0	8/12/2009	62.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223172	3278/0	9/16/2009	172.6
3278	ESTO	Lost Cr. @ State Line, Seneca	223173	3278/0	10/28/2009	235.9
3278	ESTO	Lost Cr. @ State Line, Seneca	223178	3278/0	4/13/2010	139.6
3278	ESTO	Lost Cr. @ State Line, Seneca	223179	3278/0	5/5/2010	488.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223180	3278/0	5/7/2010	517.2
3278	ESTO	Lost Cr. @ State Line, Seneca	223181	3278/0	5/12/2010	298.7
3278	ESTO	Lost Cr. @ State Line, Seneca	223182	3278/0	5/25/2010	547.5
3278	ESTO	Lost Cr. @ State Line, Seneca	223183	3278/0	5/27/2010	2419.6
3278	ESTO	Lost Cr. @ State Line, Seneca	223184	3278/0	5/28/2010	2419.6
3278	ESTO	Lost Cr. @ State Line, Seneca	223185	3278/0	6/1/2010	517.2
3278	ESTO	Lost Cr. @ State Line, Seneca	223186	3278/0	6/3/2010	579.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223187	3278/0	6/9/2010	365.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223188	3278/0	6/11/2010	1046.2
3278	ESTO	Lost Cr. @ State Line, Seneca	223189	3278/0	6/17/2010	240.0
3278	ESTO	Lost Cr. @ State Line, Seneca	223190	3278/0	6/18/2010	139.1
3278	ESTO	Lost Cr. @ State Line, Seneca	223191	3278/0	6/22/2010	547.5
3278	ESTO	Lost Cr. @ State Line, Seneca	223192	3278/0	6/23/2010	547.5
3278	ESTO	Lost Cr. @ State Line, Seneca	223193	3278/0	6/25/2010	613.1
3278	ESTO	Lost Cr. @ State Line, Seneca	223194	3278/0	7/2/2010	217.8
3278	ESTO	Lost Cr. @ State Line, Seneca	223195	3278/0	7/6/2010	365.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223196	3278/0	7/9/2010	280.9
3278	ESTO	Lost Cr. @ State Line, Seneca	223197	3278/0	7/13/2010	344.8
3278	ESTO	Lost Cr. @ State Line, Seneca	223198	3278/0	7/15/2010	727.0
3278	ESTO	Lost Cr. @ State Line, Seneca	223199	3278/0	7/20/2010	190.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223200	3278/0	7/22/2010	410.6
3278	ESTO	Lost Cr. @ State Line, Seneca	223201	3278/0	7/23/2010	410.6
3278	ESTO	Lost Cr. @ State Line, Seneca	223202	3278/0	7/28/2010	248.1
3278	ESTO	Lost Cr. @ State Line, Seneca	223203	3278/0	7/30/2010	133.6
3278	ESTO	Lost Cr. @ State Line, Seneca	223204	3278/0	8/3/2010	135.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223205	3278/0	8/5/2010	128.1
3278	ESTO	Lost Cr. @ State Line, Seneca	223206	3278/0	8/11/2010	210.5
3278	ESTO	Lost Cr. @ State Line, Seneca	223207	3278/0	8/13/2010	298.7
3278	ESTO	Lost Cr. @ State Line, Seneca	223208	3278/0	8/18/2010	249.5
3278	ESTO	Lost Cr. @ State Line, Seneca	223209	3278/0	8/19/2010	249.5
3278	ESTO	Lost Cr. @ State Line, Seneca	223210	3278/0	8/24/2010	210.5
3278	ESTO	Lost Cr. @ State Line, Seneca	223211	3278/0	8/27/2010	79.4
3278	ESTO	Lost Cr. @ State Line, Seneca	223212	3278/0	8/31/2010	260.3
3278	ESTO	Lost Cr. @ State Line, Seneca	223213	3278/0	9/3/2010	2419.6
3278	ESTO	Lost Cr. @ State Line, Seneca	223214	3278/0	9/8/2010	198.9
3278	ESTO	Lost Cr. @ State Line, Seneca	223215	3278/0	9/15/2010	143.0
3278	ESTO	Lost Cr. @ State Line, Seneca	223216	3278/0	9/16/2010	143.0

Water Body	Org.	Site Description	Sample ID	Site Code	Date	E. coli (cfu/100 mL)
3278	NCHD	Lost Cr. @ Seneca	229877	3278/0.4	4/3/2012	461.1
3278	NCHD	Lost Cr. @ Seneca	229878	3278/0.4	5/1/2012	435.2
3278	NCHD	Lost Cr. @ Seneca	229879	3278/0.4	6/13/2012	235.9
3278	NCHD	Lost Cr. @ Seneca	229880	3278/0.4	7/10/2012	294.3
3278	NCHD	Lost Cr. @ Seneca	229881	3278/0.4	8/14/2012	396.8
3278	NCHD	Lost Cr. @ Seneca	229882	3278/0.4	9/11/2012	198.9
3278	NCHD	Lost Cr. @ Seneca	229883	3278/0.4	10/2/2012	866.4
3278	NCHD	Lost Cr. @ Seneca	246204	3278/0.4	4/2/2013	512.0
3278	NCHD	Lost Cr. @ Seneca	246205	3278/0.4	5/14/2013	88.4
3278	NCHD	Lost Cr. @ Seneca	246206	3278/0.4	6/18/2013	613.1
3278	NCHD	Lost Cr. @ Seneca	246207	3278/0.4	7/9/2013	110.6
3278	NCHD	Lost Cr. @ Seneca	246208	3278/0.4	8/12/2013	231.0
3278	NCHD	Lost Cr. @ Seneca	246209	3278/0.4	9/9/2013	160.7
3278	NCHD	Lost Cr. @ Seneca	246210	3278/0.4	10/7/2013	816.4
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	246211	3278/7.0	4/2/2013	557.0
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	246212	3278/7.0	5/14/2013	105.0
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	246213	3278/7.0	6/18/2013	74.9
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	246214	3278/7.0	7/9/2013	1119.9
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	246215	3278/7.0	8/12/2013	189.0
3278	NCHD	Lost Cr. Nr Racine@Hwy CC	246216	3278/7.0	9/9/2013	173.6
3279	MDNR	Little Lost Cr. nr mouth	310113	3279/0.1	8/12/2021	103.9
3279	MDNR	Little Lost Cr. nr mouth	310111	3279/0.1	7/21/2021	307.6
3279	MDNR	Little Lost Cr. nr mouth	310112	3279/0.1	8/12/2021	167.0
3279	MDNR	Little Lost Cr. nr mouth	312653	3279/0.1	9/9/2021	78.9
3279	MDNR	Little Lost Cr. nr mouth	312654	3279/0.1	9/29/2021	90.8
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	514	3279/0.9	4/3/2007	1413.6
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	515	3279/0.9	4/10/2007	1553.1
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	516	3279/0.9	4/17/2007	648.8
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	517	3279/0.9	4/24/2007	686.7
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	518	3279/0.9	5/1/2007	214.1
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	519	3279/0.9	5/9/2007	365.4
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	520	3279/0.9	5/15/2007	613.1
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	521	3279/0.9	5/23/2007	98.3
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	522	3279/0.9	5/29/2007	4839.2
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	523	3279/0.9	6/6/2007	166.4
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	524	3279/0.9	6/20/2007	166.4
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	525	3279/0.9	7/5/2007	151.5
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	526	3279/0.9	7/10/2007	248.9
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	527	3279/0.9	7/17/2007	110.6
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	528	3279/0.9	7/24/2007	980.4
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	529	3279/0.9	7/31/2007	110.6
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	530	3279/0.9	8/7/2007	328.2
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	531	3279/0.9	8/14/2007	648.8
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	532	3279/0.9	8/21/2007	249.5
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	533	3279/0.9	8/28/2007	198.9
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	534	3279/0.9	9/4/2007	156.5
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	535	3279/0.9	9/11/2007	184.2
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	536	3279/0.9	9/18/2007	155.2
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	537	3279/0.9	9/25/2007	488.4
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	229884	3279/0.9	4/3/2012	1553.1
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	229885	3279/0.9	5/1/2012	816.4
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	229886	3279/0.9	6/13/2012	365.4
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	229887	3279/0.9	7/10/2012	613.1
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	229888	3279/0.9	8/14/2012	11.8
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	229889	3279/0.9	9/11/2012	81.3
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	229890	3279/0.9	10/2/2012	228.2
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	246217	3279/0.9	4/2/2013	336.0
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	246218	3279/0.9	5/14/2013	184.2
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	246219	3279/0.9	6/18/2013	178.2
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	246220	3279/0.9	7/9/2013	183.5

Water Body	Org.	Site Description	Sample ID	Site Code	Date	E. coli (cfu/100 mL)
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	246221	3279/0.9	8/12/2013	201.5
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	246222	3279/0.9	9/9/2013	51.2
3279	NCHD	Little Lost Cr. @ St. Louise St. Br Seneca	246223	3279/0.9	10/7/2013	48.8
3279	MDNR	Little Lost Cr. On Condor Rd	310114	3279/3.8	7/21/2021	36.8
3279	MDNR	Little Lost Cr. On Condor Rd	310115	3279/3.8	8/12/2021	70.3
3279	MDNR	Little Lost Cr. On Condor Rd	312656	3279/3.8	9/9/2021	40.8
3279	MDNR	Little Lost Cr. On Condor Rd	312657	3279/3.8	9/29/2021	161.6
3279	NCHD	Little Lost Cr. On Condor Rd	541	3279/3.8	6/9/2005	101.4
3279	NCHD	Little Lost Cr. On Condor Rd	542	3279/3.8	7/18/2005	365.4
3279	NCHD	Little Lost Cr. On Condor Rd	543	3279/3.8	8/28/2007	648.8
3279	NCHD	Little Lost Cr. @ Hwy CC, nr. Condor Rd	544	3279/5.5/1.2	6/14/2005	151.5
3279	NCHD	Little Lost Cr. @ Hwy CC, nr. Condor Rd	545	3279/5.5/1.2	7/18/2005	4839.2
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	546	3280/0.2	6/14/2005	280.9
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	547	3280/0.2	7/13/2005	1732.9
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	548	3280/0.2	4/3/2007	198.9
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	549	3280/0.2	4/10/2007	114.5
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	550	3280/0.2	4/17/2007	167.0
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	551	3280/0.2	4/24/2007	1119.9
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	552	3280/0.2	5/1/2007	770.1
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	553	3280/0.2	5/9/2007	488.4
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	554	3280/0.2	5/15/2007	153.9
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	555	3280/0.2	5/23/2007	739.8
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	556	3280/0.2	5/29/2007	816.4
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	557	3280/0.2	6/6/2007	101.7
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	558	3280/0.2	6/20/2007	160.7
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	559	3280/0.2	7/5/2007	201.4
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	560	3280/0.2	7/10/2007	248.1
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	561	3280/0.2	7/17/2007	325.5
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	562	3280/0.2	7/24/2007	156.5
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	563	3280/0.2	7/31/2007	248.1
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	564	3280/0.2	8/7/2007	98.5
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	565	3280/0.2	8/14/2007	91.0
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	566	3280/0.2	8/21/2007	235.9
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	567	3280/0.2	8/28/2007	146.7
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	568	3280/0.2	9/4/2007	162.4
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	569	3280/0.2	9/11/2007	344.8
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	570	3280/0.2	9/18/2007	85.7
3280	NCHD	Willow Branch @ Racine, Hwy 86 and CC/K	571	3280/0.2	9/25/2007	64.4
3280	NCHD	Willow Br. @ Iris Rd.	229891	3280/2.3/1.0	4/3/2012	25.7
3280	NCHD	Willow Br. @ Iris Rd.	229892	3280/2.3/1.0	5/1/2012	435.2
3280	NCHD	Willow Br. @ Iris Rd.	229893	3280/2.3/1.0	6/13/2012	128.1
3280	NCHD	Willow Br. @ Iris Rd.	229894	3280/2.3/1.0	7/10/2012	83.6
3280	NCHD	Willow Br. @ Iris Rd.	229895	3280/2.3/1.0	8/14/2012	770.1
3280	NCHD	Willow Br. @ Iris Rd.	229896	3280/2.3/1.0	9/11/2012	20.5
3280	NCHD	Willow Br. @ Iris Rd.	229897	3280/2.3/1.0	10/2/2012	44.1

Appendix B
Development of *E. coli* Load Duration Curves

Overview
The load duration curve approach was used to develop the *E. coli* TMDLs for Lost Creek, Little Lost Creek, and Willow Branch. Load duration curves visually display the loading capacity of a water body at all possible flows based on historical flow data and the defined target concentration for each pollutant. For Lost Creek, Little Lost Creek, and Willow Branch, 10 percent of the loading capacity is reserved as an explicit margin of safety. The remaining portion of the loading capacity is allocated to nonpoint sources.

Methodology
Load duration curves are based on a flow duration curves developed using a long-term time series of daily flows and a numeric water quality target. Average daily flow data that are representative of the impaired segment are used to develop the flow duration curve. If sufficient flow records for the impaired stream segment are not available, then flow data collected from a gage in a representative watershed may be used, or a flow duration curve can be derived by synthesizing long-term flow data from several gages within the same ecological drainage unit.

Because there are no USGS stream gages in Lost Creek, Little Lost Creek, and Willow Branch, the load duration curves are based on a flow duration curve derived by synthesizing over 17 years of daily average flow data recorded at four USGS stream gages in or near the Neosho ecological drainage unit, as shown in Table B-1. Nash-Sutcliffe statistics are calculated for each gage flow record in order to determine if the relationship is valid for each record. The Nash-Sutcliffe statistic evaluates the efficiency of a predicted (modeled) flow dataset (Nash and Sutcliffe 1970). An efficiency of 1 (100 percent) describes a perfect match, while values less than zero indicate a poor fit of modeled and observed datasets (USGS 2010). This relationship must be valid in order to use the synthesized flow methodology. Model estimates are considered satisfactory if Nash-Sutcliffe statistics are greater than 50 percent (USGS 2013). The flow duration curves for each reference stream and the resulting synthesized flow are depicted in Figure B-1. The synthesized flow duration curve was adjusted to the watershed areas of each impaired stream to produce the flow duration curves for each stream as displayed in Figures B-2, B-3, and B-4. The mean, minimum, and maximum flows estimated for each stream are shown in Table B-2.

The *E. coli* TMDLs in Section 7 were developed by converting the whole body contact category A *E. coli* criterion of 126 cfu/100 mL or the whole body contact category B *E. coli* criterion of 206 cfu/100 mL to pounds per day based on the flow duration curves and a conversion factor of 24,465,715 in order to generate the loading capacity in units of cfu/day. Despite the varying load, the target concentration is constant at all flow percentiles and reflects the static nature of the water quality standards. The observed data provided in Appendix A are plotted on the load duration curve graphs in Section 7 to demonstrate the magnitude of load reductions that are needed to meet the TMDLs and attain water quality standards.

Table B-1. Stream gages used to develop synthesized flow

USGS Gage	Drainage Area (mi^2)	Period of Data	Nash-Sutcliffe (%)
USGS 07188653 Big Sugar Creek near Powell, MO	141.0	5/2007-10/2021	95%
USGS 07189100 Buffalo Creek at Tiff City, MO	60.8		73%
USGS 07189542 Honey Creek near South West City, MO 48.7	48.7		95%
USGS 07185700 Spring River at La Russell, MO	306.0		76%
		Mean:	**85%**

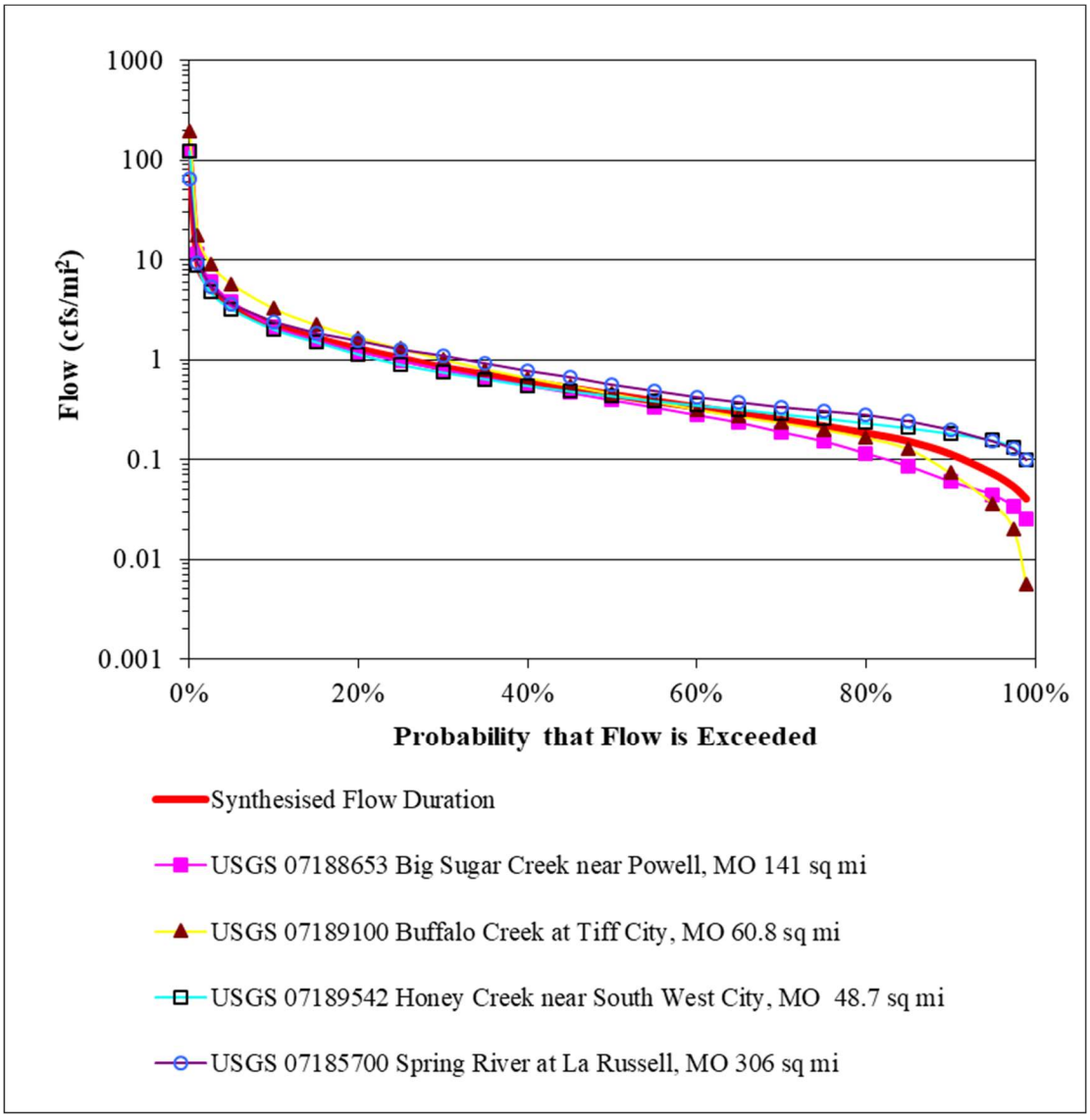

Figure B-1. Area-based synthetic flow duration curve

Table B-2. Mean, Minimum, and Maximum Flow Estimated for Each Stream

Stream	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
Lost Creek	1.54	64.41	5771.84
Little Lost Creek	0.46	19.37	1735.39
Willow Branch	0.10	13.52	1336.02

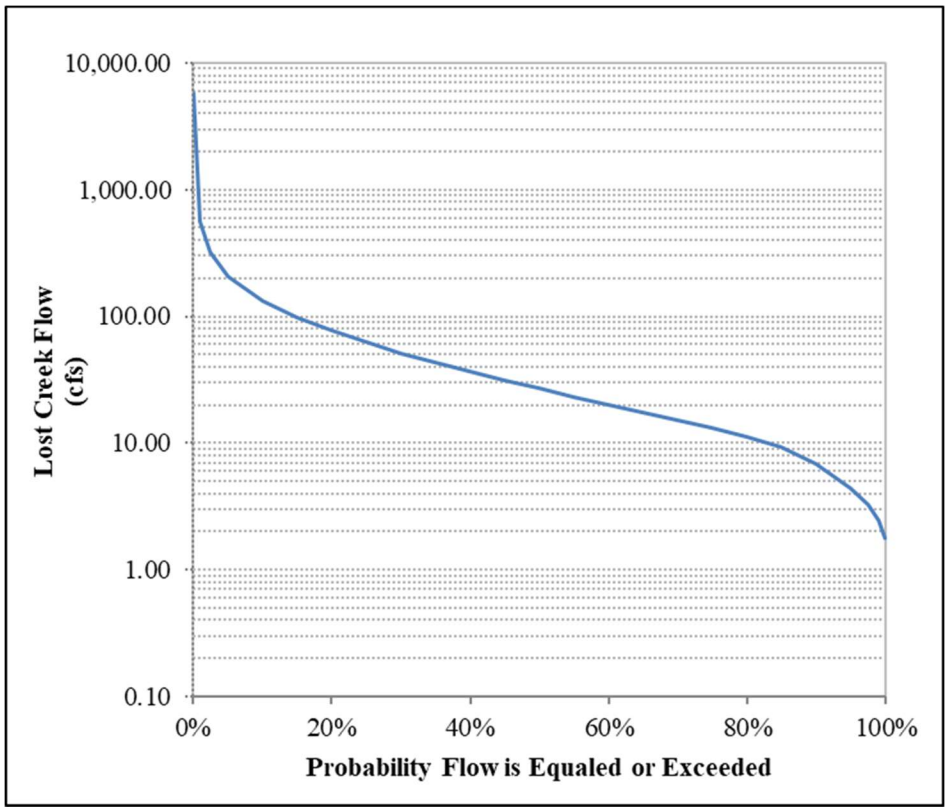

Figure B-2. Lost Creek Flow Duration Curve

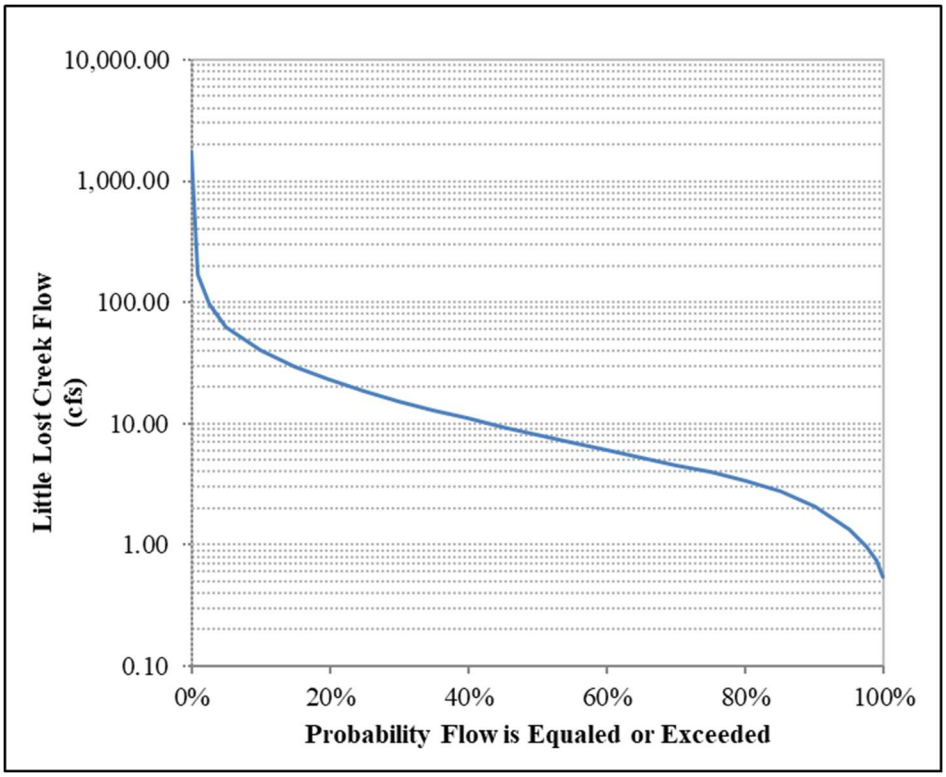

Figure B-3. Little Lost Creek Flow Duration Curve

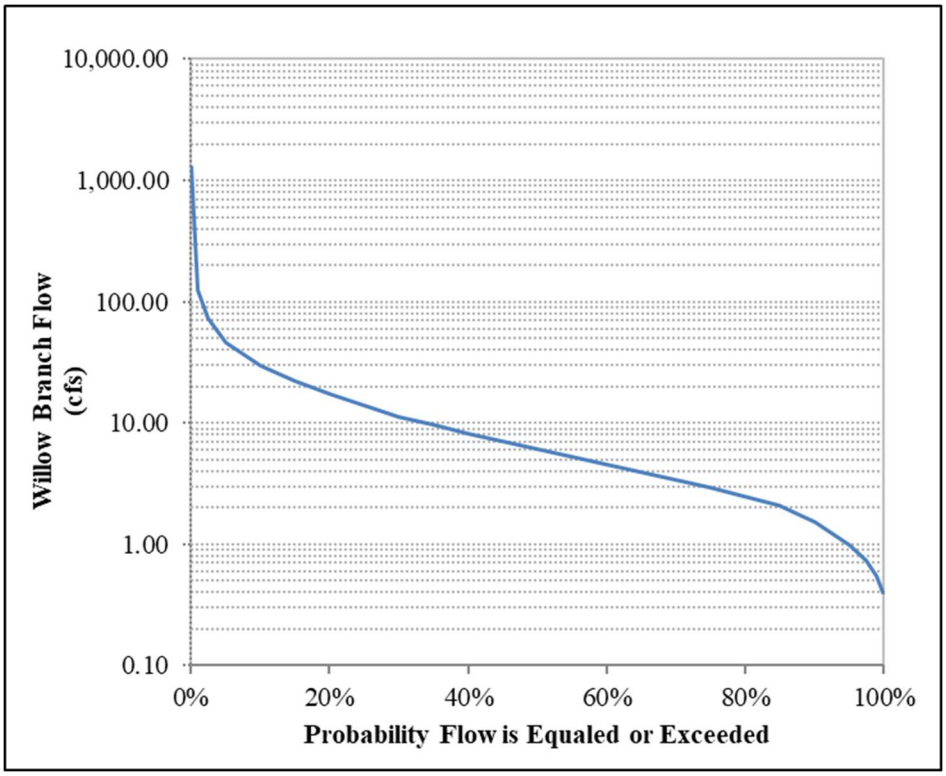

Figure B-4. Willow Branch Flow Duration Curve